SEVENTY-THIRD YEAR

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The Heaviest Submarine Telephone Cable

NANTUCKET, an island off the southern coast of Massachusetts, with a population of 3,000 in winter and nearly five times that number in summer, has until recently remained one of the few communities in the United States without long distance telephone connection. This was not because the people there preferred their isolation, but because such length of submarine cable as would be needed was thought impossible.

The coil perfected by Professor Pupin of Columbia, which made possible the transcontinental telephone, is the basis for new possibilities in marine cables, and has led to the laying of a 24-mile cable from the mainland to Nantucket, the longest submarine cable in the United States. The island, in exchange for loss of its isolation, receives the distinction of being the terminus of this line, which represents the very latest development in science.

The new cable follows the route of the telegraph cable laid some years ago; from the mainland to the island of Martha's Vineyard, and from there across to the farther island, Nantucket.

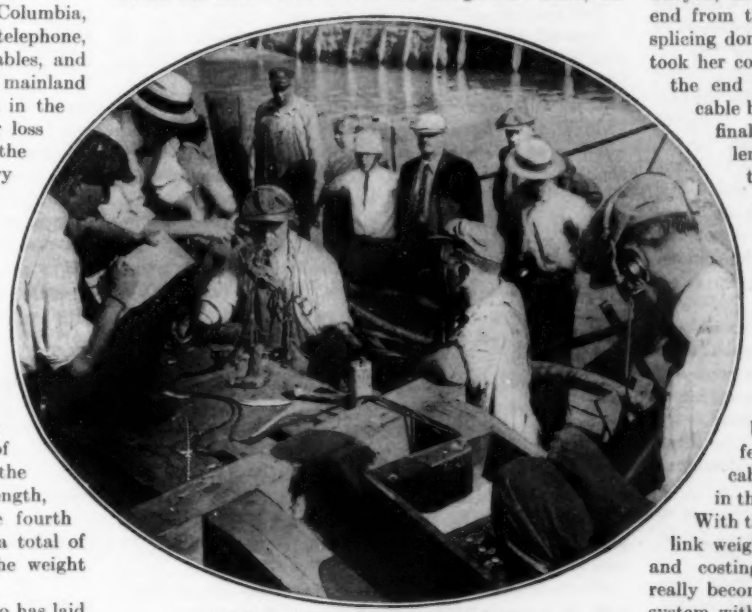
Twelve flat cars carrying approximately twenty-four miles of cable were shipped to Wood's Hole, the nearest point on the mainland. Two reels at a time were unloaded and stowed away on the cable laying steamer, the "Robert C. Clowry," three miles of it being wound on the great paying-out drum in the bow. The four reels, three of 6,100 feet in length, weighing over 70,000 pounds each, and the fourth of 2,900 feet, weighing 26,000 pounds, made a total of 21,200 feet weighing 111 tons exclusive of the weight of the reels themselves.

On the "Clowry" was Alexander Kline, who has laid 90 per cent of the marine cables in the United States. His work takes him from coast to coast, and in thirty-five years he has laid seven lines across Vineyard Sound, under which the Nantucket cable also passes. Speaking of this last achievement, Mr. Kline remarked: "We have handled many a cable on the Atlantic coast and on the Pacific. We laid the Vancouver cable, the longest telephone cable in the world, but these 24 miles are my top-notchers."

The first cable to go aboard was the 2,900-foot length; to it was spliced a 6,100-foot reel, making a total of 9,000 feet weighing 54 tons. The cable from the mainland to Martha's Vineyard weighs 10.6 pounds to the running foot; from that island to Nantucket it weighs but 4.9 pounds. The ordinary deep-sea cable weighs about two tons to the mile, the new Vineyard Sound cable weighs thirty-five tons. Nowhere is there a long submarine cable of such weight. The terriffic tides which ebb and flow through the Sound necessitated this extraordinary weight, which proved very difficult to handle.

The work of splicing the unwieldy, almost unmanageable line was tedious and difficult, the first splice requiring over eight hours, owing to the frequent tests made on the carefully protected copper wires. As a precaution and as a matter of record these checking-up trials were rigorously followed out. Each wire inside the shields of metal and sheaves of cordage was incased in vari-colored paper. The colors were used by the engineers as code signals to see that the wires were properly placed to avoid cross-talking. Owing to the unique character of the Nantucket cable the officials embraced every opportunity to gather information for future work.

The "Clowry" was unable to carry the bulky cable over "Middle Ground," as a long bar of sand is called, so the line was run out in the shape of an immense figure eight and placed on a scow of lightest draft, which was then towed over these dangerous shoals, an approximate distance of 6,000 feet, by motor boat.



Testing the capacity of the circuits

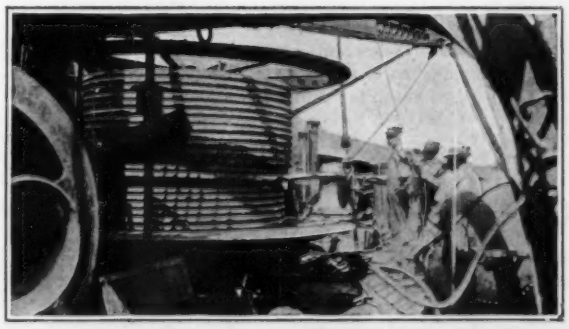
Arrived at the Vineyard shore the cable was carried landward on hemp rope reinforced with wire, which ran from the "Clowry" to a block 2,000 feet away and back again. The cable house is 300 feet further inland, and here the new line was joined to the cross-island wires.

The end of the cable, capped with metal cover and further protected by wooden splints and heavy lashings, was buoyed up by barrels and floats placed at frequent distances as it came over the side of the steamer. Lashed to the endless round of rope, pulled by a steam winch on the boat and a gang of husky men with oxen on the shore, the line which means so much to the islanders was safely got ashore and put away in the cable-house with but one mishap, the breaking of the wire rope when the task was almost completed.

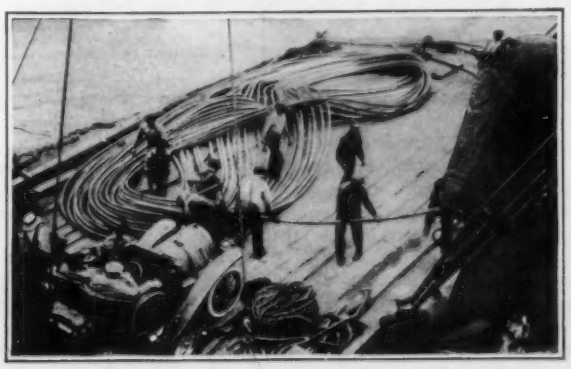
The last leg of the cable, from island to island, was laid in three sections—one from the Vineyard shore out to sea, one from Nantucket out to sea, the ends being buoyed, and a center section, spliced in. The buoyed end from the Vineyard shore was picked up, and the splicing done aboard the "Clowry." The steamer then took her course by compass, in a dense fog, to pick up the end buoyed out from the Nantucket shore, the cable being paid out as she progressed. When the final splicing was accomplished, and the entire length of cable was stretching across Nantucket Sound, there was but 200 feet of cable left on the steamer, showing careful and painstaking figuring on the part of the officials in charge of the work.

On the Nantucket shore the cable box is located 150 feet from the beach, the cable being buried so that the only visible part is where it enters the box. For hours cable experts, with numerous delicate instruments, applied first one test and then another, seeking all possible kinds of trouble, but none developed. Everything was perfect, and the efficiency of the Nantucket cable, in which 550 miles of steel wire was used in the armoring alone, was assured.

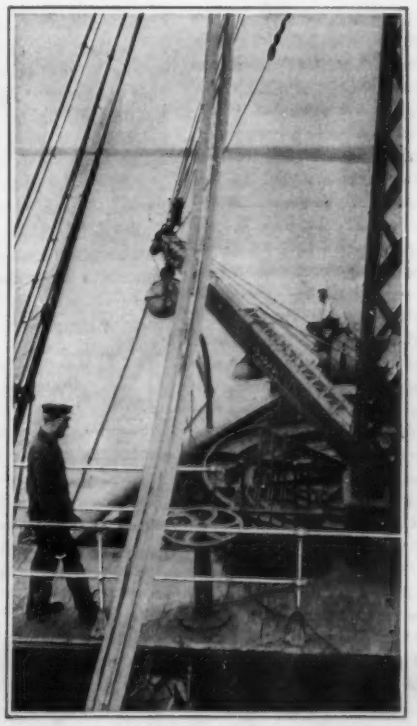
With the opening of this double armored connecting link weighing over three-quarters of a million pounds, and costing about $100,000, the Nantucket people really become a part of the great continental telephone system with its nine million stations, a matter of great rejoicing to the islanders and to the thousands of summer visitors.



One of the cable reels on the cable laying steamer



The cable laid out in a figure eight on a scow in order to be ferried across the sand bar



Showing the great paying-out drum in the bow of the "Robert C. Clowry"

Meteorology in the War

AT the outbreak of the European war Germany mobilized her most able meteorologists, organized a "field weather service," began utilizing pilot-balloons to furnish information concerning the upper air-currents to military aeronauts, and in other ways applied the science of meteorology to the art of war. It appears that other belligerent countries have followed her example. An article in *Nature* describes the valuable services rendered by British meteorologists to the land and sea forces. Special units of the Royal Engineers have been organized to serve as a "meteorological field service." The unit serving in France is commanded by Major Ernest Gold, of the Meteorological Office, who has won the D. S. O. for his military exploits. A unit in the eastern Mediterranean is under the command of Captain Wedderburn, honorary secretary of the Scottish Meteorological Society, assisted by Lieutenant Kidson, of Canterbury College, New Zealand, and magnetician in the service of the Carnegie Institution of Washington. Major H. G. Lyons, a veteran officer of the Royal Engineers, has general over-sight of the work on the Mediterranean. These meteorologists have undertaken a wide range of duties apart from the mere prediction of weather; *e.g.*, the investigation of the upper air, the study of surface atmosphere in its relation to gun sighting, range finding, etc.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Preparedness and the Private Shipyards

IT is now some fifteen years ago that one of the leading officials of our Navy Department requested the writer of the present article to arrange for a meeting to discuss a most serious matter affecting the interests of the United States Navy. The subject was the indifference of the private shipyards of this country to the vital interests of the United States, as shown by the fact that they were neglecting governmental in favor of private shipbuilding contracts, with the result that it was taking from five to six years to complete a battleship. This gentleman, who was one of the ablest and most zealous of that admirable body known as the Naval Construction Corps asked if the SCIENTIFIC AMERICAN would not use its influence to impress upon the country and its Congress the necessity for speeding up naval construction.

At that time private shipyards had matters entirely in their own hands. Warship construction was a comparatively young industry; only a few yards possessed the plant and the technical and industrial force necessary for the construction of warships and government work had come to be looked upon as a stop-gap to keep the force busy in the slack times when private orders were few and far between.

The remedy proposed was that a certain number of capital ships should be given to the government yards, where the work was to be put through with proper zeal and expedition, and a standard for rapid construction set up to which the private yards would have to conform. A certain amount of government work was given to the Navy Yards, and the time of construction was cut down from twenty-five to thirty per cent, and, as was inevitable, there was a general speeding up of work on private contracts, the time of construction of capital ships being brought, within a few years, up to the standard in British and other foreign yards.

An incidental effect of this movement was to produce a loud outcry on the part of the private yards that the Government was entering into unfair competition, and that by its action it was taking away from a struggling industry a considerable part of the work by which alone it was possible to keep the private yards going. These facts are matters of record, and they will be well within the memory of that part of the public which follows with intelligent attention the growth of the United States Navy.

The breaking out of the European war revealed to the more thoughtful among the citizens of this country the weakness of our Navy compared to that of the leading naval powers. But unfortunately (since it led to the loss of a year and a half of priceless time), the Administration deprecated making any considerable addition to our naval and military forces, on the ground that to do so would excite the suspicion of foreign powers and might render this country ineligible to act as the mediator between the warring nations, whenever the time should arrive for such mediation. Fortunately the intelligence of the great mass of the American people saw the absurdity of such an ultra-altruistic attitude; and the silent protest which was fermenting in the minds of the people took shape in the formation of certain great patriotic and non-political movements, of which the largest and most effective was the National Security League. The doctrine that it was the immediate duty of the State to increase its naval and military defenses to the point at which the country would be secure against outside interference, had only to be clearly stated to make a strong appeal to the whole country. The great national principle as thus enunciated ran like a prairie fire from coast to coast, finally voicing itself in a series of unprecedented preparedness parades, in which over a million of the best citizens of the country thus gave expression to their convictions.

This vast national movement was nothing more nor less than an emphatic mandate, spoken in no uncertain tone to the Congress and the President, who, at once, with commendable discretion, completely reversed their policy and proceeded to translate the will of the country into practical form by voting some $700,000,000 for the increase of our naval and military forces.

Now, considered merely as a beginning, a starting point, this was a most excellent and encouraging result, and it is to the credit of Mr. Daniels, the Secretary of the Navy, and his immediate associates, that they have at once set themselves zealously to the task of building the great fleet of 157 ships, the construction of which was authorized by Congress.

In view of the historical facts which we have outlined in the earlier part of this article, it was natural to expect that the great shipbuilding companies would have risen to the occasion with patriotic ardor, and would have brought their shipbuilding facilities to bear in the effort to lay down these ships and rush them to completion with all possible expedition. If they were anxious to secure government orders, if they were possessed of a tithe of that patriotism which had expressed itself in the national preparedness movement of the previous year, here surely was their grand opportunity. The Navy Department apportioned to the Navy Yards such ships as they possessed facilities for building and the private yards were invited to come forward and accept the responsibility for the construction of the remainder.

Did they do so? They did not.

Instead, they showed a positive reluctance to put in bids that were at all possible of acceptance, and in respect of the largest of the capital ships, the battle-cruisers, although they were well aware that this was a time of great national emergency, they made the impossible and positively ridiculous proposition that they should be given from four to nearly four and a half years' time in which leisurely to build these urgently needed ships.

We use the words "positively ridiculous" advisedly; for we have it on indisputable authority, as we mentioned recently in these columns, that at least two great battle-cruisers, of approximately the same size as those which our private firms want four years or more to build, have recently been completed in two different yards on the Clyde within the space of eighteen months. The British yards, it is true, are working two shifts of ten hours each; but even at that, the disparity between eighteen months and four years and a half is such as to give ground for a very reasonable suspicion that the private shipbuilders find orders for the merchant marine more profitable than naval orders, and therefore have put in bids for our new ships which they know perfectly well the Navy Department will never accept.

Of course, working in two shifts means the employment of a much larger labor force and the payment of a higher wage. But supposing it does; the extra investment would be but a drop in the bucket compared with the cost of a war which found us unprepared. Great Britain, caught unprepared is now spending enough money to build a couple of battleships each day, and her war outlay for a single fortnight would pay for the Panama Canal. Let us not lose our sense of proportion. Let us remember that the passage of the great Naval Defense Act was crisis legislation, and in estimating the cost of putting this bill through, let us think of it less in terms of what we are now spending and more in terms of the colossal war expenditure which we can avoid only by doing swift emergency work to-day.

Secretary Daniels, who is showing the greatest energy in getting the ships of the new program upon the stocks, should receive the strong support of Congress in this endeavor. He may rest assured that the country is behind him in his request for $12,000,000 to lay down shipbuilding ways at the Navy Yards so that the Government may have done with the contractors and put the ships in hand itself. The country is with him also in his determination, should it prove to be necessary, to secure legislation making it obligatory upon the steelmakers and shipbuilders of the country to give Army and Navy contracts the preference over private work.

Competitive Bidding at a Disadvantage

NOT so long since a member of our editorial staff chanced to be holding a conversation with a builder of periscopes in the office of the latter. At first the conversation dealt entirely with the purely technical aspects of the periscope; but after a while it drifted into a discussion of the comparative merits of the periscopes employed on our own submarines and those on the German U-boats. There followed a number of facts which cast an interesting light on the existing system of the United States Government of awarding contracts for Army and Navy equipment on a competitive basis.

Our legislators were right in introducing competitive bidding and making it legal. In most instances competitive bidding for government contracts is as warranted as it is in the commercial world. But on occasion this form of awarding government contracts is at fault: indeed, it may even become a menace and work directly against those ends for which it was formulated, namely, the securing of the best products at the right prices. Let us see how this works out in practice, taking for the present example the case of periscopes for submarines:

In Germany, and for that matter in practically all the leading powers of the world, the equipment purchased by the government for either the military or naval forces must be of the best. It must, furthermore, represent the last word in the development of apparatus of its kind. Accordingly, the Government, keeping in intimate touch with all fields that contribute to the armed forces of the nation, selects a certain man, or organization, who is recognized as the leading producer of certain apparatus or equipment. And that man or organization is awarded a government contract for the apparatus or equipment desired. He is left free to make his product as well as he knows how; and without financial restrictions nor unreasonable time limits, the recognized authority is enabled to serve his Government in a manner truly worthy of a good citizen. There is obviously no reason why he should slight any detail of his work, since all expenses and efforts are to be well paid for. In a word, the making of the apparatus or supplies is not a commercialized undertaking: it is a patriotic duty.

Compare, then, this admirable system with that existing in our own country. When the Government desires special equipment or supplies it draws up concise specifications which are distributed to persons or firms in a position to supply the articles called for. Since it is a case of competitive bidding, each interested party bids as low as possible consistent with meeting the terms of the specifications. And usually when the contract is awarded the margin of profit is such that the contractor can ill afford to put in any extra labor or material into his product. Hence it follows that any improvements or extra care that might be available in the quality of product to which the producer aspires must needs be forgotten, since the Government is apparently interested in price above all other considerations.

Frankly, is this state of affairs fair to us? The periscope manufacturer in question claims that he is in a position to make a product equal to the best produced by any nation. He has scores of unique ideas which could be incorporated in the instruments he makes for the Government; but unfortunately the policy of competitive bidding precludes the introduction of these features. Hence our submarines are handicapped by their inferior periscopes, and in view of this and other instances, it would not be amiss for exceptions to be made in the competitive bidding system in cases that allow of extra efforts and the incorporation of valuable ideas on the part of producers.

"Anti-Zep" Aeroplanes

IN spite of the tendency to exaggeration in the reports of the new war material which is being developed in Europe, it is possible to sift out the true from the false, and there is good reason to believe that the British in their latest aeroplanes have found an effective answer to the Zeppelin.

When the first raids on London were made, the British possessed neither the guns nor the aircraft in sufficient numbers or quality to meet, destroy or drive back the latest Zeppelins. The anti-aircraft guns could not reach effectively the great heights to which the Zeppelin could rise, nor could the aircraft rise in time to attack. Since that time both guns and aircraft have become thoroughly efficient for the work. Just in what numbers and of what caliber are the anti-aircraft batteries with which London is now so well defended, is not known; but, because of the great value of high velocity and a straight trajectory for anti-aircraft gunfire, it is a pretty safe guess that there are many batteries of guns larger than the 3-inch. The 50-caliber 4.7- and 6-inch gun, if fired at high angles of elevation, have a trajectory of slight curvature and the time of flight is small, elements which simplify the task of the gunner in finding and keeping on a moving target.

Information is now available as to the new anti-Zep aeroplanes, and Lieut Faulkner of the Royal Flying Corps, who recently landed in New York on furlough, has given some details which agree with information we have received from another source. The problem has been to build an aeroplane with climbing powers sufficient to enable it to reach Zeppelin altitudes in time to meet the raiders and bring them down. The latest machines are of comparatively small wing surface and are driven by unusually powerful engines, capable of making speeds of 120 to 140 miles per hour. The increase in climbing speed in the past few months has been truly astonishing, having progressed from an ascent of 10,000 feet in 6 minutes, to 15,000 feet in 7½ minutes. The scouting service, both on the North Sea and along the East coast is now so effective that London is warned of the approach of the Zeppelins in time to permit the Zeppelin chasers to take the air and be in position for an attack before the raiders reach their objective. Various means are used by the airmen to bring down the enemy, the most effective of which is the incendiary bullet, which is described at length in another column.

Naval and Military

Universal Training Is Popular.—The various speakers sent out last year by the National Security League were greatly surprised to find that even the most casual mention of universal service was invariably received with acclamation by the audience, and the subsequent reports on the agitation for such service, whether by the press or by civilians, or by the officers of the regular Army, have strongly confirmed the impression thus gained. General Scott, the chief-of-staff, has come out strongly in favor of this movement, and General Wood, basing his belief upon the remarkable results obtained during the brief intensive training which was given to the Plattsburg men, believes that if the youth of this country were given a period of six months intensive training at the age of nineteen, the country would at once be provided with an efficient reserve of 500,000 men, which would be increased in successive years until we possessed a force amply sufficient for the defense of the country.

Long-Range Gun Practice in Our Navy.—In accordance with the experience of the war, the gun practice of our battleships has been carried out at ranges far in excess of any heretofore prescribed. A comparison with the year 1914, when full charges were used in guns, shows results gratifying to the Navy Department. The individual practice of the main battery guns was conducted at a mean range of over 15,000 yards, as compared with a mean range of 10,000 yards, with the same guns in 1914. In spite of an increase of over 50 per cent in range, the percentage of hits was not only maintained, but showed a slight increase. We are glad to note that full charges are being used; for, when three-quarter charges were used, the velocity being less and the angle of fall greater, it followed that the danger space at the target and the chances of hitting the same were reduced. Consequently, although the gun pointing may have been as good, the number of hits made was smaller—a fact which tended to produce discouragement among the gun crews. This factor is of great importance, and in our opinion greatly outweighs any advantage of economy due to the smaller charges used.

Smoke Screen as Defense Against Submarines.—If merchant ships were to make use of the smoke screen, they would find it to be a very effective defense against submarine attacks. If a merchant ship on sighting a submarine turns at once to windward and chokes off the draft of her fires, she can throw behind her a heavy cloud of smoke which would be very baffling to the enemy. If the ship were an oil burner the screen would be particularly effective, for oil smoke is dense, slow to dissipate, and settles low upon the water. The submarine would hesitate to use her superior speed to close in on a ship which she could not see, particularly if she knew that the merchantman, as soon as the submarine became visible through the smoke, would be prepared to open on her with a 6-inch gun. Merchantmen shonld be armed with nothing less than a 4.7 or 6-inch piece, since these in the hands of a gunner at all expert would be sure death to a submarine steaming at the surface. The armament should consist of four of these guns, one forward, one aft and one on each beam. The difficulty, of course, would be to provide quickly sufficient of these guns to arm the 4,000 ships of 2,000 tons and upward, in the British Merchant Marine.

Zeppelins for the Navy.—In view of the useful work done by the German Zeppelins in scouting over the North Sea, it certainly would be the part of wisdom to have some of these machines developed for our own naval service. It is generally admitted by the British that the Zeppelins have been of the greatest service to the German Navy in such offensive operations as they have ventured to carry on in the North Sea. It is generally believed that these scouts have been employed, day in, day out, in observing the disposition and maneuvers of the British, and because of the wireless reports sent home, the German Admiralty has been kept very thoroughly informed as to where the British fleets, squadrons and flotillas were cruising, on what course they were steaming, and what was their strength. The Zeppelin has reached a size, speed and extended radius of action, which enable it to go far afield with comparative independence of the weather, and remain in designated localities for considerable periods of time before returning to its shed. It is true that the majority of our naval men favor the use of powerful seaplanes, carried either upon special seaplane tenders, or upon the after deck of our fast scouts. They believe that if our 35-knot scouts, for instance, were spread out over a wide area, and that if each carried three or four seaplanes, they could move out swiftly in widely extended order in search of the enemy, and by sending out their planes could make a swift and very thorough reconnaissance on a line hundreds of miles in length. Although this is undoubtedly true, we believe that a moderate number of Zeppelins of the largest size would constitute a valuable auxiliary to the aeroplanes and greatly diminish the chances of the enemy's scouts breaking through without detection.

Science

The Faintest Known Variable Star.—Mr. Harlow Shapley reports that a star in the southern globular cluster Messier 9 (N.G.C. 6333) shows a conspicuous short-period variation, with a range exceeding a magnitude. As the photographic magnitude of this star, at its maximum, is less than 16.5, it is probably the faintest variable star thus far discovered.

Potatoes as Ensilage.—On result of the efforts made in recent years to ensure a more complete use of the potato crop is the development by the U. S. Bureau of Chemistry of a simple and practical method of ensiling potatoes, without cooking or the use of pure cultures. To the crushed raw potatoes is added a starter consisting of 1.5 to 4 per cent of ordinary corn meal. The loss resulting from fermentation is negligible, and cattle and hogs eat the product freely.

Statistics of Cancer.—At the request of the American Society for the Control of Cancer, the U. S. Census Bureau has prepared a monograph presenting, in much greater detail than in the mortality reports issued by the bureau, statistics relating to deaths from cancer and other malignant tumors throughout the registration area in the year 1914. Deaths are classified under 7 general headings and 27 sub-divisions, each indicating the particular part or organ of the body affected. The Public Health Service has coöperated in the compilation of this report.

Women in Engineering Work.—The Ministry of Munitions of Great Britian is making a special appeal to university women and other women with a good education to join classes for training in skilled branches of engineering work. Classes are being opened in London, and the complete course lasts from eight to nine weeks. To those who pass a preliminary test at the end of a fortnight or three weeks a maintenance allowance is to be paid for the remainder of the course, and when proficiency is attained a minimum wage of about $10 a week may be expected.

Plants and Calcareous Rocks.—Many plants are classed in botanical works as calciphilous (lime-loving), and the idea has prevailed that the occurrence of such plants might serve as an index of the calcareous nature of the underlying rock, and furnish useful information to the field geologist in this connection. In order to test this idea, Mr. E. T. Wherry, of the U. S. National Museum, has made a chemical study of the habitat of the walking fern, *Camptosorus rhizophyllus*, which is commonly described as calciphilous. Samples of rocks and soils on which colonies of the plant were growing were collected at some twenty places in four states. Analyses showed that the rocks supporting the growth of this fern are by no means necessarily calcareous, but that the soils in which it grows are rather high in both total and soluble lime. Probably this is true of calciphilous plants in general.

Lighthouses in the Philippines.—When the United States took possession of the Philippines only 29 lights of all classes were in serviceable condition on the coasts of the islands, and of these only a few were actually in operation, as many had been extinguished during the revolution against Spanish power previous to the American occupation. Many stations had been damaged or partly destroyed by the insurgents, and the rest had been sadly neglected. At the present time there are 151 lights of all classes, including 4 first-order flashing, 1 second-order, 9 third-order, 8 fourth-order, and 12 sixth-order flashing; 20 sixth-order occulting; 9 automatic flashing acetylene; 2 electric; and 85 minor fixed lights. The system is, however, far from complete. The total coast-line of the islands is about equal to that of the combined Atlantic, Pacific and Gulf coasts of the United States, not including Alaska, and there are more than 5,000 nautical miles of coasting routes and tortuous channels regularly navigated by vessels trading among some 300 separate ports.

Progress of the Biological Survey.—The biological surveys of the United States, conducted by the Bureau of Biological Survey, were begun in 1889, and the work is approaching completion in many parts of the country. The survey of Wyoming was completed in 1916. and several other states in the west and south will have been fully surveyed with respect to their biological features within the next two years. The work consists of determining the distribution, abundance and habits of the birds and mammals of the states. and also the distribution of the principal plants, in order to secure information for publications, which will be of use to the public in the conservation of animal life, and also to obtain data by which the boundaries of the natural "life-zones" may be determined, for both practical and scientific purposes. Skilled field naturalists traverse the state, working the mountains, valleys and plains in sufficient detail to ascertain the distribution of the fauna and flora. Field notes are made on the habits of birds and mammals, especially in reference to their food habits; stomachs are obtained for laboratory investigation, etc. The final reports are prepared in Washington from the collation of field reports and a study of specimens.

Electricity

Insulators for the Chains of Pull Sockets.—Splicing links and insulators are now available for use on pull socket chains, which can be used either as a splicing link or an insulator or for both. The insulators are for use mostly in baths, kitchens and basements, where there is a possibility of the consumer's circuit becoming grounded or a transformer breaking down and causing a high voltage on the house circuit, with fatal results to anyone touching the pull socket chain under the circumstances.

Two Rheostats in One.—Two rheostats combined in one compact unit, one a step rheostat for coarse regulation and the other a slide wire rheostat for fine graduations, are features of a device that has just made its appearance. It is particularly applicable to such work as the checking of voltmeters, watt-meters, watt-hour-meters, etc. The rheostats furnish voltage values anywhere between zero and the voltage value of the source to which they are connected. In cases of emergency the apparatus being tested can be disconnected from the device by a safety button, which can only be reset by returning the control to zero.

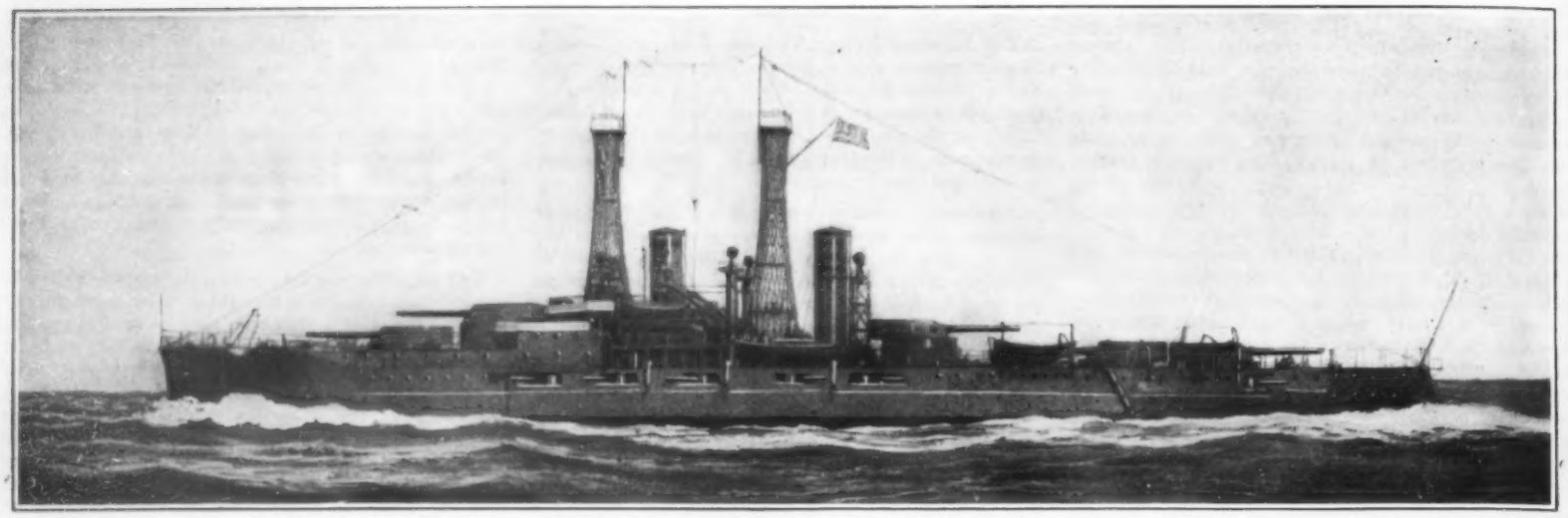
Hydro-Electric Power in Spain.—It appears that there are now 50 hydro-electric plants with an available horse-power of over one million, working in Spain. It is estimated, however, that it is practicable to produce from water quite 6,000,000 horse-power, continues *The Electrician*, of which over one million could be derived from the river Ebro and its affluents. Capital for such developments has in the past been provided mainly in France and Great Britain. It is hoped that the interest of these countries in the matter will not be lost owing to the vast war expenditures.

A Bicycle Lamp which fulfills a dual function has lately made its appearance. On fairly lighted streets it can be burned low so as to warn pedestrians and drivers of other vehicles of its approach, and on unlighted or poorly lighted streets and country roads it can be brilliantly lighted in order to illuminate the roadway ahead so that the driver can ride in safety. The present bicycle or motorcycle lamp makes use of a double-filament lamp operating on two cells of dry battery. The filaments are controlled by a three-way switch, and by turning to the high point the lamp produces two candle-power, and by turning to the low point the lamp produces but one-half candle-power.

A New Current Rectifier.—When there are placed in an alternating current circuit two electrodes of which one is a metal and the other a metallic oxide the latter will not permit the current to pass except when it is used as the cathode, but the metallic oxide thus employed rapidly disappears. A German scientist named Donath has recently succeeded in making practical use of this property by employing as a cathode a pencil of chalk surrounded by a spiral of flat iridium wire. The volatilized chalk is deposited upon the spiral and the electrode can thus be made to last about a thousand hours. The electrodes are immersed in argon or in mercury vapor according to the intensity of the current. The performance of such a rectifier under 10 amperes and 120 volts is 60 per cent. Its principal advantages are its small volume and its low net cost.

Electrical Fire Logs, which have been used on the stage for several years, are now available for other uses. These fire logs are made of imitation wood, consisting of three or more logs naturally grouped for interior fireplaces and outdoor camp-fires. The logs are of translucent material and asbestos, reinforced with metal, and are made hollow for the insertion of electric bulbs. The bark and cut ends of the logs are artistically designed and hand painted to give the natural appearance of partially burned logs. By properly shading the translucent and opaque parts and providing for reflection from below, the logs when illuminated glow with the natural bright and darker shading of burning wood logs. The fire logs can also be obtained in the form of a large wood log with imitation ash heap, for large old-fashioned fireplaces.

Letting Electricity Do the Scrubbing.—The latest recruit to the ranks of electric labor-saving devices is a scrubbing machine. It weighs about 100 pounds and and is entirely self-contained with the single exception that it takes its current from any convenient socket. The machine wets, sweeps, scrubs and dries the floor at a single operation. It requires only a single attendant, who merely pushes the machine forward and guides it. He controls the amount of water distributed on the floor by means of the handle. This water is immediately swept up by a cylindrical brush which is 16 inches wide and has a circumference of 20 inches. This brush is driven by a one-fourth horse-power motor at a speed of 600 revolutions per minute. The brush does the actual scrubbing and carries all of the dirt and soiled water over an apron into a separate receiving pan, so the scrubbing is always done with clean water from the upper tank. The machine is said to have a capacity of nearly 7,000 square feet of surface per hour.



Length, 5 feet 4 inches. **Beam**, 10¼ inches. **Draft**, 3½ inches. **Displacement**, 56 pounds. **Speed**, 1.6 Knots. **Armor:** belt .11 inches; turrets .11 inches. **Guns:** ten .12 inch; fourteen .05 inch.

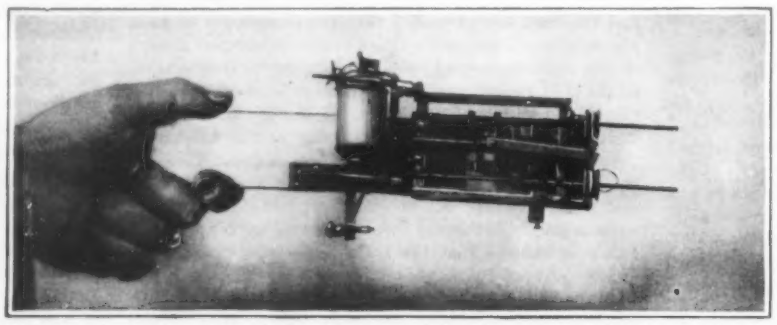
THE SMALLEST BATTLESHIP IN THE WORLD

A Working Model of the "North Dakota"

Description of a Model of a Dreadnought 1-100th of Full Size, which Steams, Steers, Fires its Guns and Performs the Functions of a Ship of the Line, as Built by C. A. Myers, Jr.

THE keel of the model of the "North Dakota" was laid in May, 1911, and she was completed by Mr. Myers in May, 1916, five years of spare time in the evenings having been required for her construction. This model differs from most others in that it is built entirely of metal, the only wood in her being the oars in the life-boats. The plates of the hull are of steel, and the method of construction was in many essentials the same as that of the original vessel. The model is built from the government plans on the scale of ⅛-inch to the foot. The length of the model on the waterline is about 64 inches, beam 10¼ inches, draft 3⅜ inches and every detail that is on the real ship is faithfully reproduced in miniature on the model, the proper scale having been followed throughout. No attempt was made to build the interior of the model like the real ship; as the idea was to construct a vessel that would actually work in water, which of course a half-model, showing the exterior on one side and the interior on the other would not do. In the process of construction cross-sections were reproduced from the plans in sheet zinc, and the lower parts having been soldered to the keel in proper relative position to one another the zinc frames were trued up and held in correct vertical alinement by cross-bracing. The width of the strakes of plating having been determined, small U-shaped grooves were made in the cross-sections at proper intervals and hard-drawn brass wire, about $\frac{3}{32}$-inch in diameter, was run from stem to stern, the forms for the cross-sections having been worked out in sheet metal and fastened to the keel in the same way as the frames. The wire was then soldered to the frames at the points of juncture, conforming automatically to the exact contour of the ship. The distance between zinc frames being at no place more than, say, two inches, the hull now presented somewhat the appearance it would ultimately have and was surprisingly strong and stiff. The steel plating (coated with tin to make soldering easy) was next put on in lengths of four to six inches and soldered to the brass wires.

Four water-tight bulkheads were provided by soldering the particular zinc frames selected for the purpose to the skin of the ship all the way round the hull. The other frames having served their purpose of giving contour to the hull were now melted out by connecting one



Wireless control outfit, built in 1904 for steering the model of the "Connecticut"

wire of the house electric light current to the hull of the ship (through proper electrical resistance of course) and the other to a hard steel pencil. By drawing an arc from the steel point to the zinc surface, the latter

One of the .05-inch guns compared with a spool of cotton

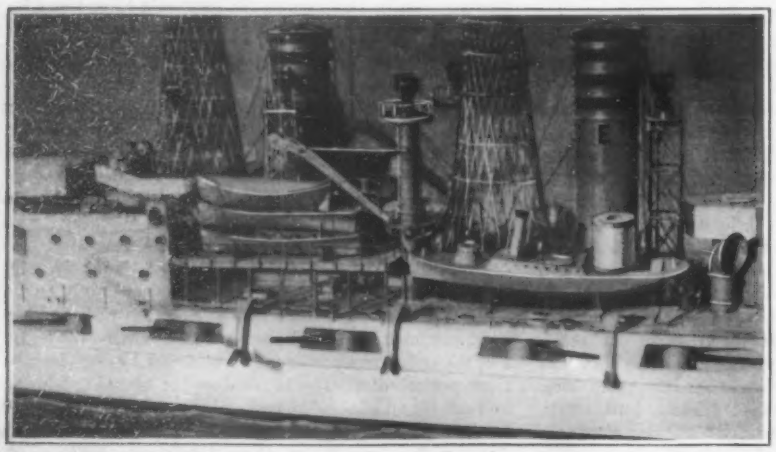
melted away like soft cheese and left the hull with three distinct zinc bulkheads between which a complete equipment of workable machinery could readily be installed.

It goes without saying, of course, that all this could not be gone into in a haphazard fashion. Before a stroke of work could be done the whole matter had to be worked out on paper and the exact displacement of the model determined. Without such a determination excessive weights might possibly have been used in certain points, so that when the model was placed in the water she would sink down so far that the deck might be nearly level with the water if indeed she floated at all. Therein lies one of the chief points of distinction of this particular model; for while it is one thing to make a boat that will run in water, or perhaps an exact model that can be kept on exhibition in a glass case, it is an entirely different proposition to build an exact model that at the same time will work in every detail and which in addition when placed in water will float at just exactly the proper load waterline and maintain the correct characteristics of stability, trim, etc. This the model of the "North Dakota" does, and to illustrate the point in question it might be added that as completed she comes within less than one pound of displacing her calculated weight.

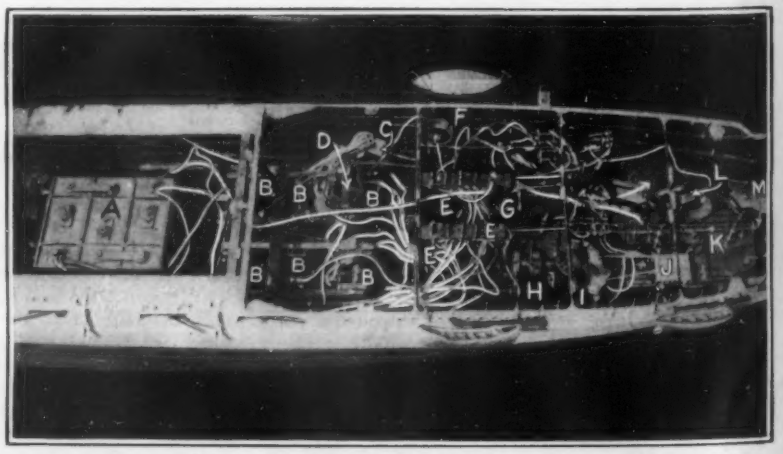
Zinc was selected for the frames because of ease of melting combined with a fairly good degree of strength, and aluminum was used for the armor-belt on account of its lightness. The protective sheath, which in the real ship is 11 inches thick, is a scant ⅛ inch on the model and is bolted to the side plating in sections just as in the case of Uncle Sam's warship.

Portholes, gun-ports, ash-chutes, electric winches and a thousand-and-one other details must be completed before the hull alone is finished. Yet the hull represents but a small fraction of the work on the entire model.

One item alone, the lattice-work masts, represents an enormous amount of painstaking care, when it is considered that each one has over 60 feet of brass wire and more than one thousand separate soldered joints.



Midship view showing .05-inch battery, boats, cranes, etc. The launch runs by steam. Note spool of cotton, showing small scale of model



Deck removed showing power and control apparatus of the "North Dakota"

A, Storage Battery; BBB, Main Driving Motors; C, Controller and Reverse; D, Motor for Turning Turret No. 3; EE, Switchboards; F, Battery for Operating Relay; G, Relay; H, Electric Disk Clutch; I, Motor for Turning Turret No 4; J, Dechorer; K, Coherer; L, Motor for Turning Turret No. 5; M, Connecting Rod from Large Spur Gear to Rudder.

Shown in detail in its proper position in the forward mast is the bridge with its "800 pound" bell, its "1,200-gallon" water tank, the binnacle, wheel and a number of engine-room telegraphs, to say nothing of a chart table with a map of New York harbor already laid out for the ¼-inch man who is to command the ship. The platforms inside the masts have ladders leading from one level to another, with grating trap doors at the top, ¼ inch or so square, that are actually hinged so as to open and shut.

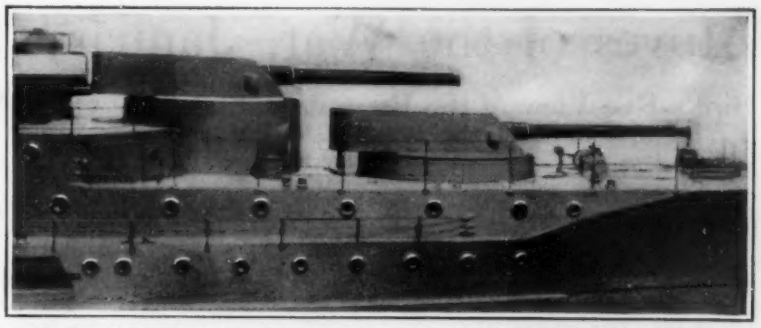
To construct the masts, a wooden mold was turned out and the position for the wires was marked off at top and bottom.

A number of small copper tacks (corresponding to the number of wires) were driven in each end of the mold and brass wires were then soldered to them and run to the proper tack at the other end where they were fastened again. The masts are smaller about two-thirds of the way up than anywhere else, and in order to remove the mold it was necessary to make it in two sections, the joint being at the narrowest point.

The turrets, each mounting two "12-inch" guns (⅛ of an inch on the model) are built of steel and are made to revolve by means of worm gearing operated by little electric motors, of which there is one under each turret. The motors are constructed with a permanent magnet for the field which makes them reversible by simply changing the direction of the current. The guns themselves are mounted on trunnions, are breech loading, and actually fire with gunpowder, the firing mechanism being operated by pressing a button on the switchboard hidden under the engine-room skylight. The guns are so connected that they may be fired one at a time, or, by throwing a switch, all ten may be fired in salvo. The effect is certainly very realistic to say the least.

The ⅛-inch bore of the guns is so small that no cartridges can be regularly obtained to fit and special ones must be made. Small brass cases less than ½-inch long contain a minute quantity of powder and a short piece of platinum wire. Upon pressing the proper button the platinum wire is heated white-hot, thus exploding the gunpowder. While the quantity of the latter is small (probably about half as much as in a .22 "short") the effect of the explosion is increased by grinding the grains of powder extremely fine. The denotation then is almost instantaneous and the explosion makes one's ears ring, the flash of fire leaping six inches or more from the mouths of the guns. The optical effect of the explosion is greatly enhanced by the admixture of about 25 per cent of powdered magnesium.

Another novel feature of this model is the installation in each of the searchlights of an extremely small but very powerful nitrogen-filled electric light. Of these searchlights the "North Dakota" has eight and when all eight are lighted they consume 30 watts, giving out more than twenty candle-power. No ungainly wires run to the searchlights, the contact being made by means of extremely minute insulated rings on which contact springs maintain a constant pressure. The lights may thus be elevated or depressed or rotated one way or another. In addition to the searchlights the model is equipped with the regulation masthead and port and starboard red and green running lights, which are also illuminated by electricity.



No. 1 and No. 2 turrets. These are operated and the guns are fired electrically

Uncle Sam's warships are all equipped with boats and steam launches and the model of the "North Dakota" is no exception to the rule in this respect. Not only has the "North Dakota" the full quota of oar propelled boats but she also has two steam launches. One is a model of a 40-footer and the other a 56-footer. These boats on the model are 5 and 7 inches long respectively, and marvelous to relate, are both driven by steam! A tiny tank in the bottom of the boat holds about as much alcohol as would a fountain pen. Mounted above this is a midget of a steam-boiler containing about a teaspoonful of water. After lighting the tiny wick of the lamp, steam issues out of an extremely fine hole toward the stern of the boat and drives it by the reaction of the atmosphere. The speed with which these tiny craft are driven through the water by this system of jet propulsion is certainly surprising. The secret of the speed of these boats lies in having an extremely fine hole for the steam to escape from; and conversely the very smallness of the hole necessitates the boiler being quite strongly made in order to withstand the high pressure which forms as a direct result. The 56-foot steam cutter may be plainly seen in one of the illustrations, also a regulation

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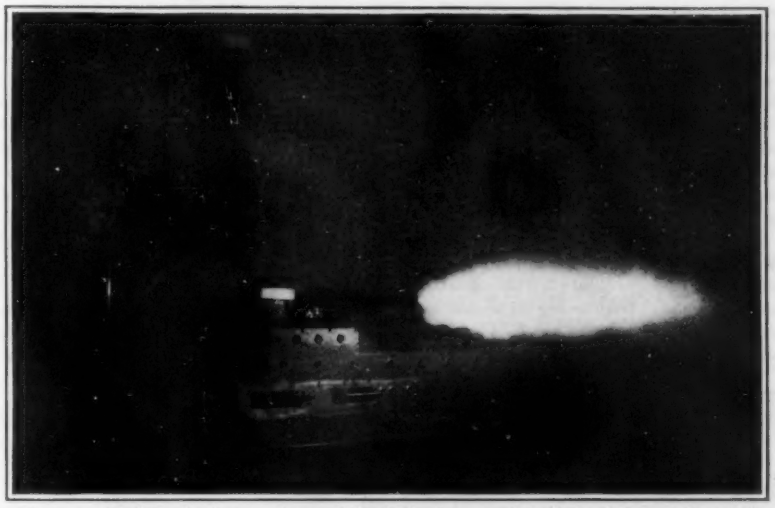
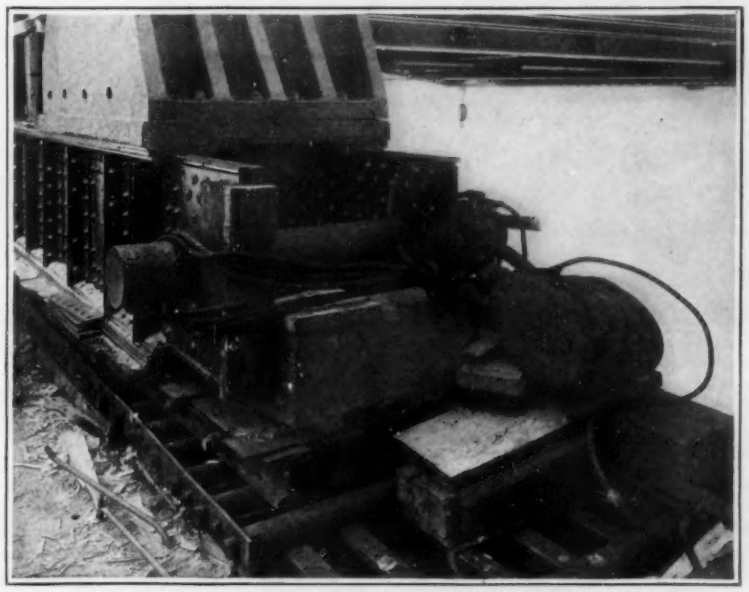


Photograph of the discharge of one of the .12-inch guns of the "North Dakota" model



Close view of the bearings for moving the Omaha bridge

More About the Omaha Bridge

LAST week we chronicled the replacing of the old Union Pacific bridge at Omaha by a new and larger structure, treating the matter wholly from the standpoint of the bridge mover. We now have further details and pictures which make it possible to indicate more clearly just what this work amounted to as a bridge building proposition, and the reader will agree with us that it involved far more of this element than does an ordinary bridge replacement.

The old bridge, erected during the years 1885-87, was a double-track structure 1,759 feet long over all. It consisted of four Whipple trusses, each 246 feet long, with three deck spans at each end. The new structure is 1,722 feet in length, made up of four Pratt spans, curved, each 246 feet long, to replace the river spans of the old bridge, with a rather miscellaneous assortment of land spans at either end to be carried upon concrete piers.

Of the entire length of the bridge, only the four main river spans were put in place by the method outlined last week. The approaches and land spans of the new bridge were substituted for those of the old by means of an elaborate system of undermining, underpinning and underbuilding, without interruption to traffic. This business of tearing the whole foundation out from beneath a large and heavy structure and replacing it piecemeal is another process, startling indeed when it was first attempted, but which has been so thoroughly standardized by modern engineering practice as to cause hardly a ripple of comment when we see it applied to the rebuilding of an elevated railroad, the construction of a subway beneath a street carrying surface and elevated lines, or even the conversion of a massive building

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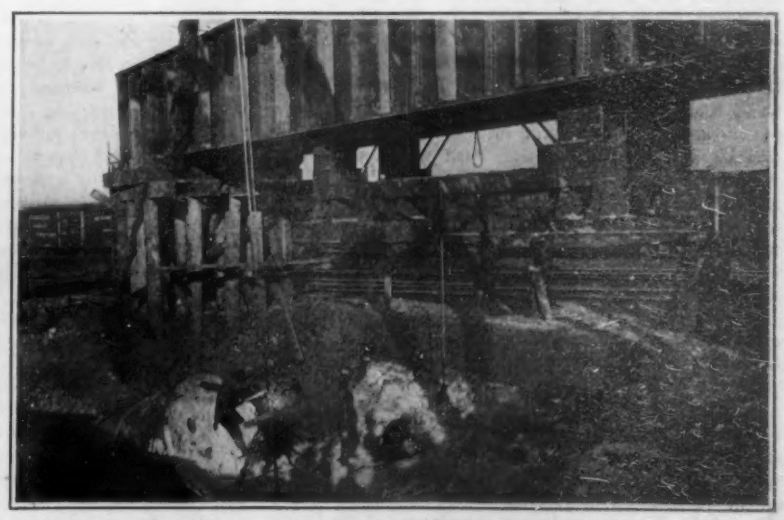
Temporary support of piles and girders to carry the bridge while permanent supports are being laid beneath



Blasting out the old masonry support of the approaches to make way for the piers of the new structure

Strategic Moves of the War, January 12th, 1917

A Bird's-Eye View of the Present Status of the Great War

By Our Military Expert

IT is not known that any better time than the present can be taken for a general view over what has been accomplished, what is under way, and what are the prospects of the contending parties in the war now in progress. We have seen the wonderful army of Germany go down in 1914 before inferior numbers at that marvel of the clash of armed foes, the Battle of the Marne, the full story of which has not yet been and cannot be written until time and full information shall clear the way for an accurate judgment. We have seen Great Britain's first quota of her regular army swept away like chaff before the wind by superior forces; yet to-day the hundred thousand that disappeared have been replaced by 5,000,000 trained men, 2,000,000 of whom are on the firing line or in the vicinity. France has sent her best and possibly nearly her all to the front and what her army has accomplished is what could have been expected from one of the best individually trained body of men, imbued with the highest ideals and love of country, and led by possibly the most intelligent officers as a whole that the world has ever seen. Russia is and has been the great enigma; defeated as she was supposed to be in 1915, she rises like the Goliath that she is, and is to-day again at the gates of Lemberg in Europe, is pushing her advance in Asia Minor and on her northwestern front is driving at Mitau.

The mystery of the failure to make full use of the Salonica forces during the year will no doubt be explained when the happenings in Athens, that would be comical if not so vital to all concerned, are explained.

The British forces in Mesopotamia appear to be once more on the move; it is safe to assume that no more disasters, similar to that most discouraging reverse at Kut-el-Amara will occur this time.

At the beginning of 1915, the prospects of the Entente Allies were far from encouraging; but German errors, such as the prolonged assault upon the fortified positions around Verdun with the frightful losses entailed, gave heart once more to their opponents. It has been estimated that the total losses in men by Germany, as regards Verdun alone, was 650,000 as against 450,000 lost by the Allies.

While Germany was thus hammering against a stone wall, the Russians under Brusiloff began their advance in Galicia which, until it was halted, in that country and in Bukowina, must have cost the Central Powers at least one and a half million men; Austrian and German prisoners alone taken by the Russians numbered 480,000—an astonishing result, even when the great forces contending on modern battlefields are considered. While quiet now prevails on that front, no doubt Russia is accumulating the reserve of ammunition she has heretofore so sadly needed, and, when spring opens if not earlier, the hibernation of the bear will end and the hardest fighting of all the years of war will take place. The rapid success of von Falkenhayn and von Mackensen in Rumania has surprised every one; it was never suspected by lookers-on that Rumania was so illy prepared for offensive operations, and she is now playing dearly for having gone northwest to Transylvania instead of to the south against her old enemies—the Turk and the Bulgar. While the Teuton forces, aided by Bulgaria and Turkey, are now beyond the Buzeu and well upon the positions on the Sereth River, everything indicates that extended military operations will cease with the occupation of Greater Wallachia and that the cry "On to Odessa" will will have no influence on the Teuton commanders.

Any great moves on any of the fronts of military operations must, until spring opens, prove of minor importance unless favorable weather permits the employment of troops in the mud of northern France or over the frozen marshes of western Russia along the Riga front. The snows of the Carpathians and of the Macedonian mountains have already checked all operations in those fields. It is unnecessary to speak here of what might be done on the Italian fronts for winter in the Alps of the Trentino and upon the plateau of the Carso and around Gorizia renders impossible any military movements of importance. The result of last year's work for the Italian armies has been a good foothold on the Carso plateau at a cost to each of the contending parties of possibly 300,000 men; on the Trentino and Gorizia fronts much of the ground formerly lost has been retaken.

On the western front the main operations of French and British offensive have been the battles on the Somme; beginning as they did in July they were kept up almost without cessation for some months and all ground gained by the Entente Allies has been held. The great superiority of the latter's artillery, shell supply, and fire control, over that of the Central Powers has never been more clearly shown than in these battles. The intensity of this fire has never been equalled in any other field. Sweeping away line after line of field trenches, this shell fire rendered all protection for the Teuton forces useless and the Allied advances in each case after proper artillery preparation were made without serious or unusual losses. However, that may be, it is estimated that Germany lost on the Somme front during the battles, probably 500,000 or 600,000 men. The Allies' losses were no doubt equally as great.

But one fact alone shows the demoralization in the Teuton ranks by the continued fighting and loss of man power. From the beginning to the end the number of prisoners constantly increased as compared with the ordinary battle casualties. There can be but little doubt that every available man of fighting age and capacity is being put by Germany upon the firing lines.

All attempts to estimate the combined losses of the contestants upon all fronts during the present year are impracticable, since so little under this head that is reliable is made known. It is believed, however, that as a whole the losses in killed, wounded and prisoners have been for the Teutons and their allies about three and a half million men; those of the Entente Allies are probably less, not exceeding two million, eight hundred thousand in all.

But a far stronger power than that of land armies is and has been silently at work and will no doubt do more than anything else to bring armed hostilities to a close. That power is hunger. Prior to the war of 1870 the countries constituting modern Germany were largely through agriculture self-supporting, but the increase of population since that time and the colonial and commercial expansions and consequent increase of manufactures have rendered it necessary for Germany to import food. This importation, just before the present war began, has been estimated at $40 per head of population. Since the war began, this importation has been cut off, harvests have not been of the best, and to-day the people of both Germany and Austria, especially of the former country, are suffering for lack of proper nourishment. So far there has probably been no actual starvation and enough food to sustain life has been obtained. But such conditions are very different from those of ample nourishment and, if reports can be believed, food riots have already taken place in many towns. There can be, of course, but one end to such a condition. An army is said to move upon its belly; and the same can be said of an entire people. Aching stomachs cannot be satisfied by a tightening of belts and by brave words of defiance. When soldiers know that their wives, children or dependents are suffering from hunger at home, they have but little heart for braving the dangers of a battlefront. And such to-day is the condition of the Central Powers—much like that of the Southern Confederacy in the dark days of the autumn and winter of 1864-1865.

Here again will be found a marked example of what is claimed for sea power by Captain Mahan in his classic—"The Influence of Sea Power on History." For the steady continued pressure of the British Navy in its blockade of German ports has cut off any marked amount of imports and is consequently largely responsible for present food conditions in Central Europe. Much has been said of the assumption by England of her present extended claims of the right of search of merchant vessels engaged in trade, especially with the Scandinavian countries. But it must be remembered that a state of war exists, national life is at stake and neutrals must expect some inconveniences and possible injustices. These have always happened in time of war and always will happen.

The sea power of Great Britain, like the folds of a serpent on its prey, is slowly but surely squeezing the economical life out of the Central Allies and the end of the war may be closer than many suspect.

With so well organized a government as prevails in Germany, it will not be safe to make too strong predictions as to an early peace, for many times so far in this war she has disappointed the fondest hopes of her opponents. The wonderful system and collaboration in her public and private industries show the powers for organization inherent in the German character; even the most bitter enemies acknowledge and admire one of the most perfectly arranged systems of government of its kind that the world has ever seen. Whether that system can and will stand against the democratic tendencies of the present day is a problem that only time can solve.

A street scene in the war-ridden territory on the Somme Front

In the foreground of this view is a so-called "dump" for aerial torpedoes or trench bombs. Contrary to the usually prevailing impression, these bombs are not dropped from aircraft. They are fired from small mortars in the trenches, and are intended to wreck the field defenses of the enemy a few hundred feet away. Each bomb is provided with a set of fins or wings which keep it head-on during its flight toward the target, and a shank which fits into the muzzle of the mortar. It has often been said that the trench bomb is among the war's most destructive weapons.

The Current Supplement

EVERY year our vigorous neighbor on the north is growing in strength and broadening in the variety of its activities, and this is especially the case in manufactures, to which the war has acted as a powerful stimulus. We are all familiar with this territory as an agricultural region, but like all things with which we have become familiar in a very general way we have overlooked the details of its progress and development. The handsomely illustrated article on *Canada* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2142 for January 20th, 1917, gives much information about the Canada of to-day which would be of value both to students of political economy and to our manufacturers and merchants. A valuable series of lectures was recently delivered before the Royal Society of Arts in London on *Vibrations, Waves and Resonance*, the first of which, appears in this issue of the SUPPLEMENT to be followed by the remainder of the series in succeeding issues. *Poisoned Arrows* describes very fully the various venoms that make the weapons of some savage races so deadly, and their action. The article is illustrated by several cuts. *Problems of Human Nutrition* discusses discrepancies in current systems of dietetics. *Spark Ignition* deals with the effect of spark intensity on ignition in internal combustion engines. *A Rotary Interrupter for Large Induction Coils* gives full technical details and instructions for building an instrument of great utility both for scientific and technical purposes. It is accompanied by complete working drawings, that show construction and dimensions. The article on *Refractory Materials* is concluded.

Wireless and the Irish Rebellion

IT appears from the reports that during the recent Irish rebellion the insurgents severed the telegraph wires, stopping communication with England. Later a rebel obtained possession of the wireless station at Stephen's Green and sent out the proclamation of an Irish Republic.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Recruiting for the Navy

To the Editor of the SCIENTIFIC AMERICAN:

On December 7th in his Annual Report, Secretary Daniels, while discussing enlistments in the Navy, showed that Congress has authorized an immediate increase of 26,000 men, only 2,524 of whom have been obtained and Admiral Fiske said lately at a New York meeting that the American people were as ignorant of their danger as a baby sitting on a railroad track. I would like to give you the experience of a personal friend of mine. He has resided in America for over 20 years and was born in Scotland. His only son was also born in Scotland, but has been here nearly all his life. Last October my friend went to a naval recruiting station with his son who wished to join the Navy and upon the recruiting officer being told that the father did not yet have out his final naturalization papers, he declared the boy ineligible for the Navy. The father and son, not to be denied, went straight to Montreal and the boy enlisted in the Canadian Royal Naval Reserve for the duration of the war, with the option of joining the British or Canadian Navy after the war. He receives $29 a month, all found, and in case of injury a pension of $40 a month for life. The boy is at present in England undergoing a thorough naval training under very strenuous conditions and at the same time getting special evening classes in electricity. Now this boy has been exceptionally well brought up in the open, can swim, run a motorboat, and any gasoline engine, and is a first-class wire rope splicer, he neither drinks, smokes nor swears and passed a very high test on eyesight and physical examinations. Of course the native born American will say: "What do we want with these foreigners in our Navy?" But when a man has lived here 20 years and has every cent of his money invested here and has brought up his son as a good clean American, and has himself taken out his papers, though he has not yet his final papers, what earthly reason can there be for refusing such an application? The time is coming, and it is not very far away, when something will have to be done to make the naval uniform more popular. How is it that in every country in the world, but this, the man in both navy and army uniform is accepted at any time, anywhere; yet only a few weeks ago I read that sailors in uniform were forbidden to enter certain picture shows. When will the great American public realize the dignity of the naval profession and feel nothing but the greatest admiration and respect for the naval man in uniform. Let us never forget that the Navy is our main defence; also that the more scientific inventions and complications are fitted into the fighting ships the more intelligence and care the sailor must have. I have repeatedly seen it stated that applications for the Navy are very heavy; but according to Secretary Daniels' figures the number accepted is very small. I have no doubt that the summer cruises for hundreds of young men make a good beginning; but it takes at least two years of the very hardest work and conscientious study to make a good sailorman.

Have we any means of knowing what the warring nations are doing in the way of navy building? We know that England is behind on merchant shipbuilding, but she has built, launched, and has to-day in service three heavily-armed, fast warships that were built in 20 months, whereas I see that the estimates of our ships run from 36 to 40 months, by the time such ships are in commission the warring nations may have made some very startling discoveries in the science and art of naval warfare. I may also add that the boy who joined the Canadian Naval Reserve went from Halifax to England in three days and 19 hours. This fact has never been disclosed before; but it shows that England has some secrets in speed that are not generally known. There is no reason why we cannot put warship construction on such a footing that it shall be made attractive to private builders. I think we should do less nagging at our naval architects and line officers and put full confidence in them. They should be left alone to work out the thousands of details with speed, armor, guns, personnel and strategy that the average man knows nothing about. I would like to see a series of moving pictures portraying the life on shipboard in the Navy, shown in all the small towns and villages, as a stimulus to recruiting.

NAVY LOVER.

Maine.

The Steam Car: One Question Answered

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 16th, Mr. F. Vaux Wilson, Jr., asks among other questions, this one: "If the steam car can go so much faster than a gasoline car, why do not its makers enter it in some of the automobile races where it has a chance to go as fast as it wants to, to prove to the gasoline car makers that the gas car is to the steam car as a snail to a rabbit?"

The information seems to be due Mr. Wilson, as well as to such of your readers as may consider this a fair question, that steam cars have for years been persistently excluded from racing events by the terms of the entry blanks. "For Gasoline Cars Only" was a very familiar phrase appearing after the description of each event on such entry blanks. Occasionally, where a free-for-all event was scheduled, the steam cars were not excluded.

In former days price and performance were the determining factors. Cars were classed as to their price, as shown in manufacturers' catalogues. Free-for-all events were, of course, open not only to stock cars, but to specially constructed cars.

Sometimes these entry blanks were very ingeniously drawn up. On one occasion, for instance, the phrase "For Gasoline Cars Only" appeared on the event for cars from $1200 to $1500 inclusive, but did not appear on the event from $1501 to $1800. There was a well-known make of steam car which had two models between $1200 and $1500, but there was no known make of steam car which had a model listed between $1501 and $1800. The whole entry list was made up in this ingenious way.

On another occasion entry blanks in various price classes had been sent out, without the excluding phrase "For Gasoline Cars Only." Steam cars were entered in all the events for which they were eligible, whereupon the manager of the meet informed the entrant that he was obliged to withdraw the original entry blanks and substitute others with the excluding phrase, and was candid enough to say that if the original entry blank stood, he would be unable to secure any gasoline car entries.

On another occasion, a hill-climbing contest, the steam car having been excluded from all price-class events, but being admitted to the free-for-all, the local dealers in a certain steam car entered their stock models in the free-for-all event for the purpose of making records to be compared with those made in the price-class events. And entrants of stock gasoline cars in the price-events protested against allowing these steam stock cars to compete in the free-for-all. They were permitted to compete, however, and showed that they were easily capable of winning the price-class events, had they been admitted.

For years steam cars were prevented from getting an officially observed and certified test on the famous Brooklands Track in England on the ground that the Governors had no formula for determining the horse-power rating of steam cars.

And the exclusiveness of gasoline cars is not confined merely to hillclimbing events and speed events. At the famous "Dust Trials" in England in 1906 a steam car won handily. Steam cars were barred from subsequent similar events. At a recent "Slow Race" in a Western city—a race on high gears without stopping—the steam car entrant was protested at the post, and when the protest was overruled, one of the best known makes of eight-cylinder cars and one of the best known makes of twelve-cylinder cars were withdrawn and did not start.

These are but a few instances, but they are typical of almost innumerable ones. They will serve, perhaps, as an intelligent answer to Mr. Wilson's question.

It is not surprising, in view of this persistent exclusion, that manufacturers and owners of steam cars should have eschewed racing; but it is rather ironical that they should now be twitted of it. PRESCOTT WARREN.

Newton, Mass.

Earthquakes and Barometric Pressure

To the Editor of the SCIENTIFIC AMERICAN:

For the past 10 or 12 days we have had a number of earthquakes in this town. The most severe was on the 20th, about 4 P. M. We are 266 feet above sea level and 40 miles from the coast. There are no signs of volcanic eruptions in this neighborhood and these earthquakes seem to be local, as towns a short distance away from here don't feel them, especially towns of high elevation such as Tegucigalpa and Santa Rosa.

We are all in the dark as to the cause. A very strange thing, to me, happens with an aneroid Barometer during these earthquakes, and for this reason I am writing you in hopes you can throw some light on the subject. For the three years that I have been here my aneroid points to the 266 feet with a slight reaction during storms, etc., but on the day of the 20th it pointed below sea level. The day was calm but cloudy. A 6 P. M., same day, after the earthquake, it worked 50 feet above sea level and we had a continuation of earthquakes during that night; and next day, and when the needle pointed to 150 feet, we had no more till the needle went back again to 50 feet, then we had the earthquakes again. I am now able with some exactness to state whether we are going to have earthquakes or not during the day or night.

Do you think that the strong winds that we are having in the Gulf of Mexico strikes this compressed air and is the cause of the shocks we feel here?

HENRY G. CHALKLEY.

San Pedro Sula, Honduras.

The occurrence of earthquakes in a non-volcanic region is normal and not exceptional. The idea that earthquakes are necessarily associated with volcanoes, as believed by Humboldt and his contemporaries, was long since disproved. All known facts in regard to the seismicity of Honduras, with a chart showing where severe earthquakes have occurred, will be found in F. de Montessus de Ballore's "Les Tremblements de Terre," Paris, 1906, p. 384 ffg. The town of Omoa, about 20 miles north of San Pedro, was the scene of a destructive earthquake in 1856. Seismicity (liability to earthquakes) is essentially a local condition, as it is due to local weakness in the earth's crust; especially the existence of "faults," where slight disturbances of equilibrium lead to the slipping of adjacent rock faces on each other. Such disturbances of equilibrium are due, at least in many cases, to variations in the loads sustained by the earth's surface. A heavy fall of rain or snow, for example, will cause local overloading. Since the atmosphere everywhere presses down upon the earth with a weight averaging about 15 pounds to the square inch (at sea-level), variations in atmospheric pressure are among the well recognized causes of earthquakes. It does not seem likely, however, that the barometer alone can in any case be regarded as a safe guide in the prediction of earthquakes: especially, the barometer as read at a single station, without regard to surrounding conditions. It would be interesting to know whether Mr. Chalkley has made allowance for the regular diurnal fluctuation of the barometer, so pronounced within the tropics, in his comparison of readings.

THE EDITOR.

A Question of Armament

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of the 7th ult, in which you published my article on the "Vindication of the Battle-cruiser," I read with great interest a letter from Mr. W. F. Johnston, which was the absolute antithesis of my contention. With your kind permission I should like to reply to this letter.

Owing to my being in France, and to certain unavoidable delays, my communication is somewhat tardy; and in the event of your considering it too late to be inserted in your correspondence column I should be greatly obliged if you could forward my letter to Mr. Johnston.

He asserts that "There are only two real types, the fast scout and the floating fortress." That is, he would eliminate such types as submarines, destroyers, and monitors—the very ships which both Britain and Germany have built in considerable numbers to meet the exigencies of war.

Further, he says that "It is true that the battle-cruiser can outpace any ship in the line, and that is *all* we can say." Has he studied the naval engagements of the present war? I should like to refer him to Rear Admiral Knight's report on the matter.

Again, after calling the battle-cruiser a mongrel and damning mongrels generally, he proceeds to give the essentials of what he terms a fast scout, which he advises the American Navy to adopt. This vessel, Mr. Johnston says, should be of 7,000 tons, possess a speed of 35 knots, and "in her battery" should mount 10-inch quick-firing guns.

One has never before heard a 10-inch gun referred to as a quick-firer, and the American Navy has not mounted this caliber for many years. But what Mr. Johnston, in my opinion, fails to see is that his "scout" is a mongrel among mongrels. It is more like a weak battle-cruiser than a fast scout, and the very vessel which could—as he puts it—"knock the socks off" his "scout" is the battle-cruiser he has so strongly condemned.

Moreover, I believe it absolutely impracticable to build a ship of 7,000 tons with a speed of 35 knots, which should carry among her other armament six 10-inch guns.

Of course, what America (and every other country) really wants is a ship of about 20,000 tons, mounting twenty-four 18-inch guns, having 3 feet of armor and possessing the speed of 45 knots.

Somewhere in France. M. K. BARNETT.

Borax for the Eyes

To the Editor of the SCIENTIFIC AMERICAN:

I note in your November 11th issue, under the heading of "Automobile Notes," that you advocate a solution of borax in warm water for the eyes.

In reference to the above would beg to say that borax is not a suitable chemical to use in the eye, but boric acid has been used to wash out the eyes for ages. It is a mild, cooling, soothing, sedative antiseptic, and most all eye washes contain it.

Borax is an alkali. A solution of borax is good for gargling the throat, but for the eyes it is not a suitable chemical.

H. L. HARRIS.

A Frenchman who has just received a loaf of bread from home by parcel post. He tries it on the spot

Economic Conditions in Germany

The Problem of Feeding, Clothing and Guarding Three Million Prisoners

By Albert K. Dawson

With photographs by the author, copyrighted by Brown and Dawson

THIS is the first of a series of articles on present conditions in Germany. The author has recently returned from an extended visit to the Central Empires where he was accorded unusual facilities to study the people behind the firing line.

—EDITOR.

A German military prison barber plying his trade. You can get a shave in prison for as low as two cents

OVER three million prisoners are in the hands of Germany and her allies at present. This means more than the population of Indiana. It also means more men to feed, clothe, guard and care for than are found in the entire Dominion of Canada. Add to this the fact that they are not all of one race or language, but represent every race from the Equator to the Arctic and speak every language in current use to-day. Complicate this still further by having them of different religious beliefs and you will get some idea of Germany's problem of what to do with her prisoners of war.

The Russian prisoners comprise the largest single group, and number about a million and a half. They are the most tractable of prisoners, simple-minded and obedient, accustomed to plain food and hard work, and to be counted as an asset rather than a liability to Germany, for they are doing most of her farm work at present. Without this Russian labor Germany could never have harvested her crops this year. They are sent out in parties of twenty-five or thirty to each village with one guard to look after them. They live with the villagers and seem to get on very well. Many of them have already married German peasant girls and it is said that fully half a million of them will remain permanently in Germany when the war is over.

Next in number come the Frenchmen, always good natured and smiling and according to the German authorities the easiest prisoners to handle. Among them are found skilled laborers, mechanics and professional men but not so many farmers.

Then follow the English-speaking races from Great Britain and her colonies; and last are those remnants of every race made up of French, Russian and English colonial troops. To mention only a few, we find Mongolians, Malays, Cossacks, Hindoos, Siks, Turcos, Gurkas, Arabs, Senigals, Hottentots, Mohammedans and Indo-Chinese. The Mohammedans will not eat pork and the Hindoos will not eat beef, and when put in the same enclosure together they fight like cats among themselves. The prison near Berlin where a large number of these odds and ends of humanity are cared for has been dubbed "The Royal Zoo."

Under international law a prisoner of war cannot be obliged to work; but there is nothing to prevent his captor from inducing him to work by a reward of some sort. Thus we find thousands of French and English working in the shops and factories of Germany; as much, perhaps, to escape the ennui of prison life as for the small pay and tobacco allowance they receive. They are very careful not to work on any product which could be used as a material of war. Thus we find them building highways and public works, working in book binderies, factories making agricultural instruments, furniture and toys, and in establishments making women's clothing and shoes; but never making anything which could be used or worn by the men in the field.

"Blue Monday" in the Russian camp. The day on which they are lined up as you see them here to take a bath

Then there remain hundreds of thousands of prisoners who will not work at all. These are parceled out over the empire and confined in the prison camps. Prison camps vary in size; but the system of housing and organization that the Germans have developed, is standard.

The prisons are usually located on high or rolling ground, with sand or gravel soil to insure drainage and healthful surroundings. The entire prison area is usually enclosed with a double barbed wire fence about 8 feet high and with the strands close together. The two fences are about 5 feet apart and between the fences a German sentry patrols up and down.

The barrack buildings are of one design (see photograph below), built of wood, with tar-paper roofs and with plenty of windows. They are heated by stoves, and as a rule have electric lights. Each man has a bunk furnished with straw sack and blanket.

Running water for washing and drinking is supplied each barrack and there is always a common bath house and laundry for the entire camp. This has shower baths, tubs and hot water and the men can go at any time to bathe and wash their clothes. The prisoners are obliged to take at least one bath a week, but this rule does not have to be enforced on the English and French; they wash as a matter of course. It is only the Russians and Orientals who must be lined up once a week, much against their will, for the Saturday bath. The Russian peasant can see no sense in bathing at any time, and the idea of letting quantities of water come in contact with his skin in winter time is simply suicidal to him.

A company of Russians being marched to the bath house under guard on a winter day is always a source of fun to the English and French, because, judging by their expressions, one would think they were going out to be shot instead of washed.

As soon as a prisoner is sent to a camp he is given a number which is painted or sewn on his clothing. He is then assigned to a barrack building housing 250 to 300 men. Here he finds that the noncommissioned officers among the prisoners have been called out by the Germans, given a special arm band, and put in charge of their own men. A French corporal has a group of his own men assigned to him. He and the other corporals in that barrack are under the orders of a French sergeant who is

The prison clock tower, designed by an architect among the men and built by the prisoners themselves

A German prison among the hills of Thuringen. Showing the prison buildings and layout, the surrounding country and a group of Russians

responsible for all the men in that building and who receives his orders from the German prison officers. This system makes it possible for the Germans to handle a large number of prisoners with a comparatively small number of German officers and men.

Each prison has an empty barrack room or a large tent set aside as a church. Here services are held each Sunday by the prisoners themselves. In one of the camps housing a great many Mohammedans, a mosque has been erected in true oriental style, including the minaret from which each day at twelve the Hoja (priest) calls the faithful to prayers.

The prison circulating library composed of books the men have received in their packages from home. After a man receives a book and reads it he puts it in the library for the use of his comrades

The food question is the one thing uppermost in the mind of every prisoner and in his opinion cannot be given too much space in any discussion. It is also the one problem which gives the Germans most concern. One of the officers in charge of prisoner food supplies of the empire told me that sometimes it appeared as if the Russians were sending their men over as prisoners in such great numbers in order that they might eat the Germans out of house and home.

It is the aim of the Germans to see that every prisoner receives enough well-cooked wholesome food to keep him in first-class physical condition. This is a long way, however, from giving him all he wants of the kind he wants and at the time he wants it. Naturally the Germans cannot maintain an *a la carte* service and cook to suit each individual or national appetite. They figure out a well-balanced nutritious ration for the mass, just as we would figure out a ration for a horse, and the men can either take it or leave it. In all the prisons I visited I never saw a man who looked half nourished or under fed; but the same men often complain that they were being starved. In no case did their appearance bear out the statements.

Speaking of national appetites, we find that what would suit the Senegal does not please the Cossack, and vice versa. The Russian peasant likes salt herring as we like turkey, but the Frenchmen abhor it. The Mohammedan will starve before he will eat pork and the Hindoo will starve before he will eat beef. Everybody likes coffee except the Englishman and he wants tea. Some of them like a little garlic in everything and some of them don't; and there you are. In one prison the officer told me that one of the Russians serving as cook in the kitchen received a sack of garlic from home. He thought he would give everybody a treat so he gave the dinner a rich Russian flavor. They are mostly Englishmen and Canadians in that camp and they nearly had a riot. Afterward the news got over to England some way and the incident became the cause of much diplomatic correspondence.

Largely on this ground we find the prisoners segregated as much as possible according to nationality. The cooking in each camp is done in steam cookers in a central kitchen. The steam-jacket cookers resemble very much those used on shipboard. Each kitchen is under the supervision of a German chief cook, but the assistants are all prisoners. The men seem more content if some one of their own nationality does the cooking, though for my part I could not see much difference. A boiled potato is a boiled potato no matter who does the cooking. When cooked the food is sent to the different barracks in small kettles carried by two men and there dished out by the officer in charge to the men. The menu differs each day, but is the same on the same day of each week. Wednesday is beef and cabbage day; Friday is fish day; Monday pork and beans. I found one Scotchman with a mathematical mind who could figure out what they would have on any given day in any given year provided they were in prison that long. His friends would say for example, "January 4th, 1919," and he would reply like a shot, "Pork and beans."

Every prison has a canteen or store where the prisoners can buy all sorts of things to eat, smoke and wear provided he has money to buy. And other prisons, usually those with many Englishmen, have restaurants where the men can take all their meals if they have the money to pay. I found many men who boarded entirely in these restaurants.

Next in importance to the food question to the prisoner is the mail from home. From what I could find the postal system is very well organized. Very few had missed a letter or package and money always came through without loss or delay. I was surprised to find that the Russians received more money from home than those of any other nationality. Probably because they are numerically so much in the majority. Next to them come the English who receive the largest per capita amount.

The men are allowed to receive all of the letters, money or packages anyone wishes to send them. They are allowed to write two letters a week limited as a rule to two pages. This limiting the pages was a necessary measure, because the officials found that some of the men with a literary turn of mind would write reams of stuff. Now the prison censor has to read all of this and it necessarily delayed the correspondence of the other men.

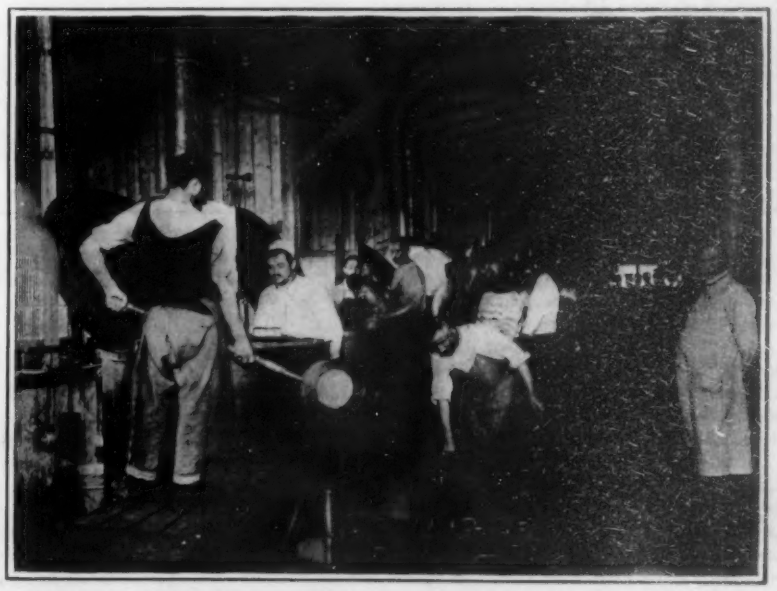
The packages they receive are limited by the international parcel post to 22½ pounds and contain eatables and sometimes clothing and books. Current newspapers, weapons and liquor are taboo. The Frenchmen like a little cognac now and then and they go to all sorts of trouble to get it through. A favorite method is to have it baked in a big round loaf of French bread or put in the middle of a thick round cheese. The officer examining these packages is supposed to confiscate such contraband but as a rule is rather lenient. Captives and captors soon come to a mutual understanding. If the prisoners are well behaved the commander does not see the bottle of wine artfully concealed in a length of sausage. If there is drunkenness in barracks then the lid goes on tight, so that the men, knowing this, do their own policing and maintain discipline in camp in order not to lose their privileges.

Packages from France and England are delivered to the prisoner in from six to twelve days from the time they are posted. I have seen them receiving butter and eggs, still fresh from the home farm. Vegetables come through in great quantities, potatoes, cabbage, beans, carrots, turnips and garlic. I saw one Frenchman who had received potatoes and lard from home doing a rushing business selling hot French fried potatoes to his comrades. He had built a little fire out in the open, on this he had placed his wash basin filled with hot fat and in this he was frying the potatoes. Another having received a stock of lemons and sugar was selling lemonade at a cent a glass.

The various sports and entertainments organized by the men themselves are most interesting. Amateur theatricals are popular where there is an empty barrack to use as a theater. Plays dealing with love and romance are always in demand, the female parts being taken by the boys of the company. Where there are Englishmen there is always football and cricket. The Russians are not much for sport but some of their peasant dances are as strenuous as a football game. I know of two newspapers being printed and published by the men in prison, one in French and one in English. Art work of various kinds is usually encouraged by the Germans, and as there are many men of marked ability in prison we find every prison with its band of sculptors, wood carvers and artists in black and white and oil. Some of the cartoons contributed to the prison newspapers are very good. In one place I found a group of five sculptors working on a large marble memorial for the prison cemetery. In another I saw a Russian naturalist making a collection of all the vegetable and animal forms found within the prison compound. He had a beautiful collection of stuffed birds and mounted butterflies.

Taking all things into consideration I believe that the men are much better off in prison than they would be if in the field with their various armies, going through the usual campaign hardships; and I know of my own experience that there have been many times while on the front that I would have gladly accepted a bowl of the prison soup.

The prison fire engine and its crew. The apparatus is also used to flush and scrub out the barracks once a week



Interior of a prison kitchen. The German superintendent stands at the right. Frenchmen are doing the cooking

Mangrove Shields of the Aboriginal Australians

A paper by Mr. Thomas Dick in the *Journal and Proceedings* of the Royal Society of New South Wales deals with the history of the *heliman* or shield of the New South Wales coast aborigines. It appears that these shields were generally made from the tough wood of the gray mangrove (*Avicennia officinalis* Linn.), and the method of constructing them was to carve a groove representing the outline of a shield on the standing trunk of the tree. This was done with a stone axe until the use of iron axes was learned from the white man. Then stone wedges were inserted, and a shield-shaped disk of wood was pried off in a single piece. The scars resulting from the removal of shields are still commonly seen on living trees in the Port Macquarie district. Some of these scars are supposed to be more than five hundred years old. On one tree nine shield marks were counted, the tree being 16 feet in girth. Mr. Dick's article includes photographs showing natives busily engaged in removing shields from the trees, but instead of the primitive tools of their ancestors they are using the most modern steel axes imported from England.

Our Waning Food Supply

What the Census Bureau Can Tell Us About the High Cost of Living

IT is plain enough that of the recent formidable rise in food prices, part is to be attributed to war's wastage and part to the fact that in all lands 1916 was a year of crop shortage. If this were all, we might look to the future with assurance, for war is temporary and crop failure occasional. But there are other and more permanent causes, at least so far as the United States is concerned; and prominent among these is land scarcity.

The more desirable portions of our public domain have been settled, and those who a few years ago would have taken out homesteads are now obliged to buy in order to secure first-class land. This has a profound effect upon the prices of land and thus upon production and supply of food; but it is not this feature which we wish to discuss here. Far more serious is the mere fact that if population increases twice as fast as does agriculture, each of us must obviously satisfy his appetite from the crops of a smaller acreage each year. This is a condition which cannot be laid to the middleman or the war or any such bogy; it must be met on its merits. That it actually exists is the purpose of this article to show.

Of the mass of available statistics, we present census figures for 1900 and 1910. While in some fields which we shall cover later data are to be had, it has seemed best to choose a single period through which all our comparisons can be made to run concurrently. The results would indicate clearly that the diagnosis suggested is the correct one.

In the first place, we find that during the decade in question the total acreage under cultivation in the United States increased from 283 millions to 311 millions. During the same period our population jumped from 76 millions to 92 millions. That is, in 1900 there were 3.7 acres under crops for every resident of the United States, while ten years later each of us had to exist upon the food produced from 3.4 acres. A decrease of 10 per cent in per capita acreage is a serious matter; it means that in some departments we must get along with less food. As a matter of fact, the effects are felt in practically all departments.

Thus, according to the best information of the Census Bureau, there were in the United States on June 1, 1900, 69 million cattle, 64 million swine and 62 million sheep, of all ages and sorts. Ten years later the figures were 68, 64 and 58 millions, respectively. So our per capita holdings of cattle, swine and sheep, respectively, fell from 91, 85 and 81 hundredths of an animal in 1900 to 73, 70 and 63 hundredths of an animal in 1910. If in 1900 and again in 1910 all the food animals of the country had been converted into meat and distributed pro rata among us, we should each have had 20 per cent less beef, 18 per cent less pork and 22 per cent less mutton in the later year than in the earlier one. And while such complete utilization is of course quite absurd, it is wholly reasonable to assume that between the properly available food animals and the total animal population a constant ratio exists, and that these figures are therefore fairly representative of the true state of our food supply. We must eat less meat than ten years ago, or pay the penalty in importation and in depletion of the living capital of the stock breeder, with the consequent present high and future higher prices.

The situation in poultry and dairy products is not quite so serious. Indeed, the decrease in the number of fowls in the United States from 3.3 per person in 1900 to 3.2 in 1910 is negligible, in view of the fact that during the same period the per capita production of eggs advanced from 206 to 209. Also, the per capita holdings of dairy cows, as well as the production of milk for each resident of the United States, remained practically stationary during the decade under discussion. But with two other great dairy products this was not the case. Each of us who consumes only his fair share must submit to a 10 per cent cut in his butter ration, from 19.6 pounds per year to 17.6 pounds; and the visible cheese production fell from 3.9 pounds per capita in 1900 to 3.5 pounds in 1910—again a decrease of 10 per cent.

This would be bad enough, under any circumstances; but if our production of staple grains were at the same time increasing we should have at once something to fall back upon, and a basis for expansion in our animal industries. Such, however, is not the case. In this same decade the annual corn crop fell from 35.1 to 27.7 bushels per capita, the production of oats from 12.4 to 11 bushels per capita, and that of wheat from 8.7 to 7.4 bushels per capita. Here we have decreases of 21, 11 and 15 per cent, in spite of the fact that the actual volume of wheat and oats harvested showed a small increase, while that of corn was stationary. So we cannot compensate for our meat shortage by eating more cereals.

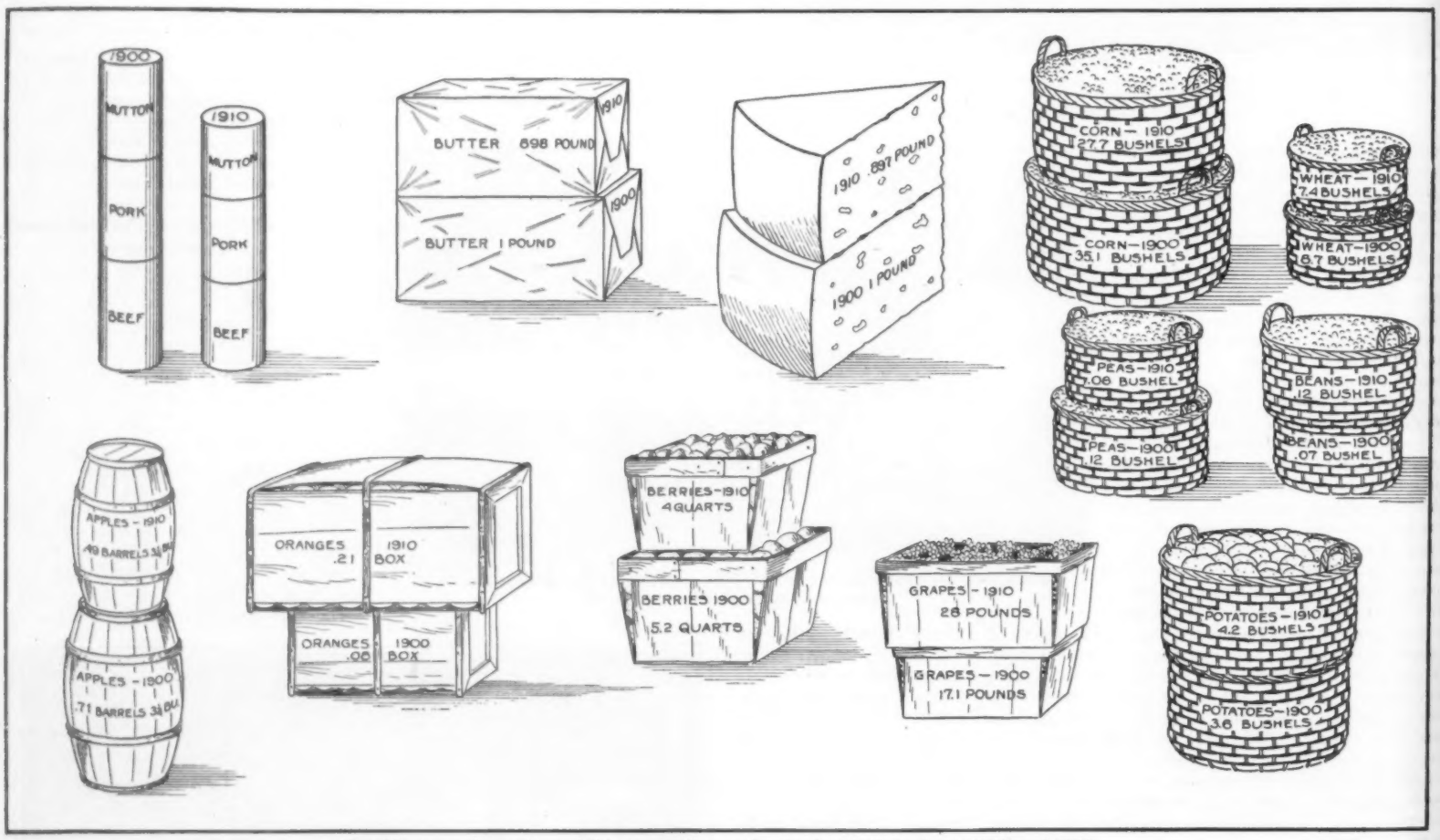
Passing from meats and grains to fruits and vegetables, we get our first ray of hope. Although, as our diagrams indicate, we are individually 33 per cent worse off for peas than we were, we have 40 per cent more beans, 16 per cent more potatoes, and 14 per cent more sweet potatoes (.64 in place of .56 bushels) per capita than before. And while apples show a terrific falling off from 2.3 to 1.6 bushels per capita, or 30 per cent, and the small berries exhibit a decline of 23 per cent, we may each have 64 per cent more grapes and over two and one half times as many oranges, as compared with ten years ago.

We may summarize these figures by noting that the supply of every variety of food which requires large expanses of land for its production, while not necessarily falling off in absolute value, has exhibited failure to keep pace with the increase in population. Vegetables and certain fruits, on the other hand, which can be grown in out-of-the-way corners and small plots of every character, together with the fruits grown on irrigated lands, have increased their production faster than the population has grown. The two circumstances confirm our original diagnosis that land scarcity is one of the roots of the evil straits in which he would eat now finds himself.

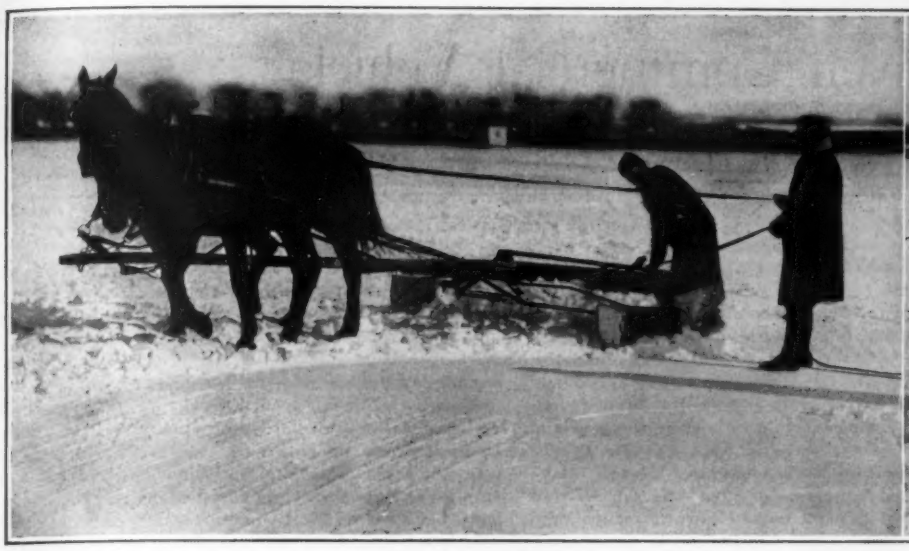
What, then, is the remedy? We have reached a point where we cannot increase the acreage devoted to grazing or to any of the staple grains without sacrificing the acreage of some other crop. Hence mere enlargement of operations on the part of the farmer will not furnish a solution. What is necessary, rather, is greater production per acre. The good old slipshod ways of farming, which were capable of feeding a comparatively thin population at a cost which represented a rather low proportion of their average wage, are breaking down under the load we have imposed upon them. For many years we fed ourselves under this system, increasing the quantity of our farming as necessity developed. Now we are reaching the quantitative limit, and must turn our attempts to improving the quality of our tilling. It is indeed the man who causes two blades of grass to grow where but one grew before who has our future in his hands, rather than he whose instinct is to make one blade sprout where none was seen before.

The farmer must take a leaf from the book of the dairyman. The latter, when he found the old farm system inadequate to keeping pace with the demand for his goods, borrowed the ideas of the manufacturer and invented the creamery. Here, in what the census enumerator justly classifies as a factory, 28 per cent of the butter of 1900 was made, and 39 per cent of that of 1910. The corresponding figures for milk production would be even more startling.

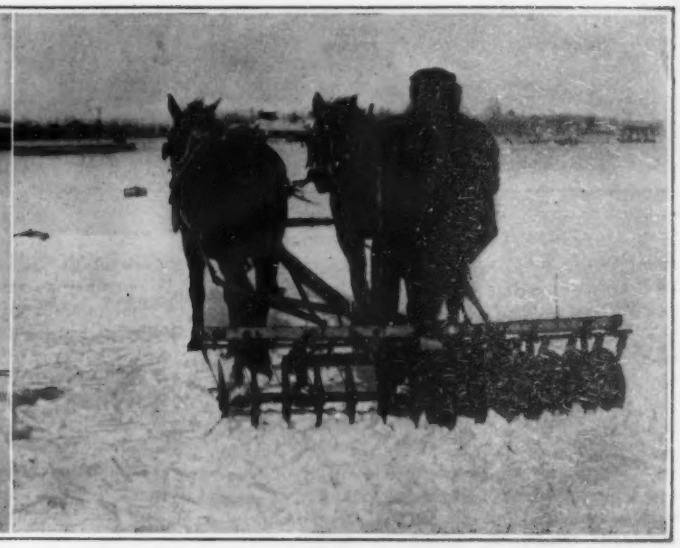
Not until the general farmer does get this viewpoint will he be able to catch up with the game. Like the manufacturer, he must look upon his land as a machine, and if this machine is not running to its maximum capacity for a maximum of time, he should be dissatisfied and feel that he is suffering actual loss. He is improving; he is more efficient than his father. But the most casual comparison of his actual performances with the standard which public and private experiment has shown to be clearly attainable will make it plain that he has yet far to progress. The farmer who is content with 12 bushels of corn and 8 of wheat to the acre, when his neighbor is getting 40 and 18, is defrauding himself, and the rest of us as well, by his own shiftlessness.



Graphic comparison of our visible per capita supply of a few food staples in 1900 and 1910



Following the breaking up of the snow crust by some suitable means, this scoop is employed to clear the ice surface



Few methods are more expeditious than the use of the conventional disk harrow in breaking up a snow crust

Harvesting the Ice Crop

A LARGE part of the ice consumed yearly in this country has its origin miles or hundreds of miles away, on the surface of some quiet lake. During the winter the ice industry or ice harvest furnishes employment to a large army of men; and if it is true that the cold weather or winter brings to a complete halt many industries and occupations in the rural districts of our northern States, it is equally true that the ice harvest offers lucrative employment to those desirous of work.

Ice harvesting lends itself to the use of machinery to a moderate extent, but the extent of the employment of machinery is in direct proportion to the importance of the ice harvest. Quite naturally, a small harvest does not warrant the equipment that a larger harvest does. And it is equally true that the methods employed vary with the region, although they all agree in general principles.

The first operation in ice harvesting is to clear the snow off the ice. For this purpose a conventional type of type of disk harrow is often employed, which, as will be noted in the accompanying illustration, effectually breaks up the snow crust into small pieces that may readily be cleared away with the horse-drawn scoop also shown.

Then follows the cutting of the ice into large cakes, the cutting being started at the end of the body of water nearest the gang saws and ice house, so that the cakes can be conducted, raft-like, to the gang saws or scoring saws illustrated on the front cover of the present number. The ice harvesters, equipped with long spiked poles, guide the ice cakes under the scoring saws which cut straight across the cakes, which are then broken up into long strips. In a subsequent operation the strips are cut up into the familiar pieces of ice, which are carried by a continuous conveyor into the ice house where they remain an indefinite time, awaiting the call of the consumer.

A Portable Skating Rink

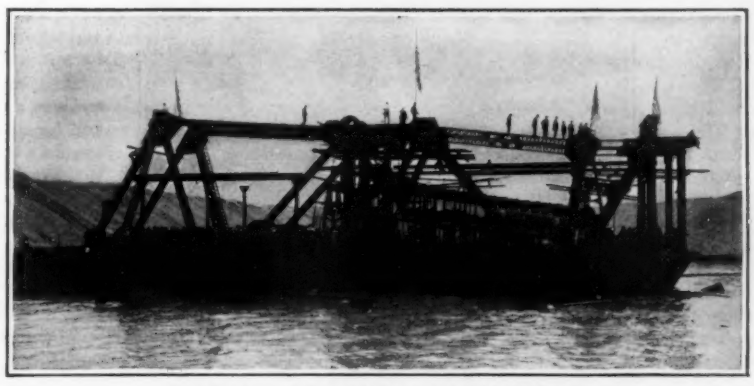
By William H. Eaton

WHEN a New York show, which is now touring the country, announces its spectacular ice-skating ballet in your town, you will probably wonder where the ice is coming from. There is no tank in the local Opera House; and even if there were, how could they freeze it? Perhaps visions of a string of ice wagons bringing in the rink in sections will arise in your mind, but a few moments' reflection will show that this is not the solution of the problem. The solution is, however, simple enough, but interesting because, of necessity, ordinary means must be used under very unusual conditions.

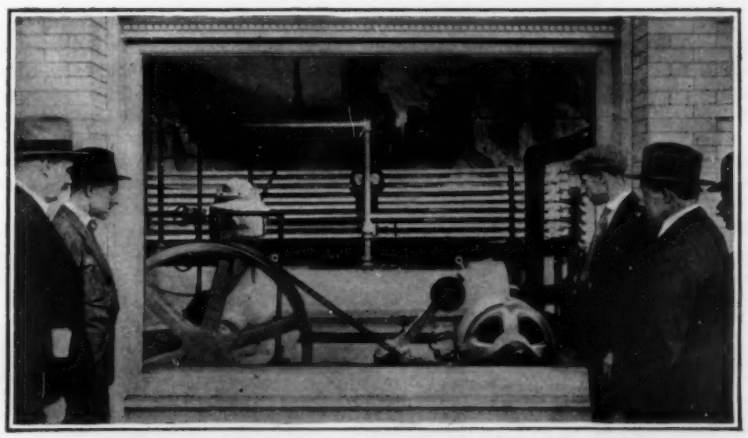
A waterproof canvas tank, or, rather, tray, 40 feet long, 20 feet wide, and 4 inches deep, is laid on the stage and is filled with water, forming a shallow pond. Inside this pond is laid a series of pipes and the water is frozen solid by passing brine, made very cold by a refrigerating machine, through these pipes.

The refrigerating outfit is of the ordinary type and consists of a 10-ton ammonia compressor driven by a 20-horse-power electric motor, with two small motor-driven pumps to circulate the brine. Each part of this plant, is, however, mounted on a skid or stand, so that it can be readily transported. When the show closes, the piping is taken down and the various units are hauled onto a truck, loaded into a car, and shipped to the next point.

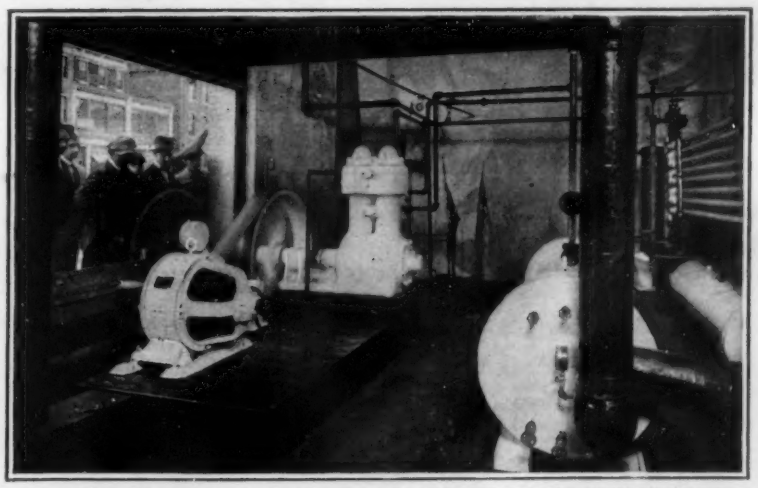
Considerable time is, of course, required to take down and erect the plant and freeze the water, so that two duplicate outfits are used; while one is working, the other is being put up at the next stand, so that all is in readiness when the company arrives there. The first plant then goes on to the next place on the route.



The launching of the largest gold dredge



The portable refrigerating plant serving as a window exhibit



Portable refrigerating plant with which the ice for the skating ballet is frozen

Launching the Largest Gold Dredge

IN this era of tremendous ship building, launchings are every-day occurrences, but there was one recently that was particularly unique. At Hammontown, Cal., was launched the largest gold dredge in the world. This huge mass of machinery was constructed almost entirely of the heaviest steel, and as it slid into the water it resembled one of our battleships. But no guns were visible, for this ship is designed for the peaceful purpose of searching for gold in the waste lands along the Yuba River.

The dredge, which cost over half a million dollars, weighs over 2,550 tons, and is operated entirely by electricity furnished by nine huge motors capable of generating 1,072 horse-power. The hull is 160 feet long, 60 feet wide, and 13 feet deep. It is built entirely of steel. The digging ladder of plate girder construction is 136 feet long, and can dig to a depth of 85 feet under water. Each of the 90 manganese steel buckets which make up the revolving chain on the digging ladder weighs over two tons, and can hold sixteen cubic yards of earth at one time. The dredge works night and day, and can handle from 10,000 to 12,000 cubic yards of earth every 24 hours. These dredges can produce thousands of dollars of gold from land too deep or too poor in the precious metal to warrant operating under the ordinary mining conditions.

Trachoma Hospitals

THE U. S. Public Health Service has been extending its campaign against trachoma—a disease of the eye characterized by granulated inner surfaces of the eyelids with inflammation of the membrane—waged by means of small hospitals in known infected districts, and now maintains six of these hospitals; three in Kentucky, and one each in Virginia, West Virginia and Tennessee. All these establishments are rapidly gaining in favor with the local communities. Besides serving the purpose for which they were primarily intended, they act as centers of knowledge and interest with regard to public health and personal hygiene. The hospital at Hindman, Ky., will shortly be abandoned, as the region which it serves, and which when the work began in 1913, was heavily infected with trachoma, is now practically free from the disease. At the five hospitals maintained during the last fiscal year (the one in Tennessee not having yet been established), the daily attendance was 19,530, and a total of 112,055 treatments were given during the year. The number of cases recorded as cured was 916, but this represents only those actually seen by the physicians in charge, and known to be cured.

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

New Creeping Grip Tractor

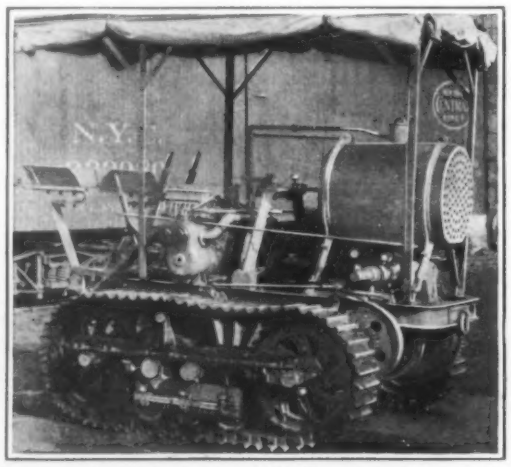
THE track laying principle has been applied in various forms of agricultural tractors in different ways. In most of the tractors where the traction members are of this type, supplementary wheels are provided at the front end to carry a portion of the weight and to assist in steering. The design illustrated is of a different construction inasmuch as no wheels are utilized except those included in the traction members. The machine has a very short wheel base and can really be considered a mobile stationary power plant that can also be used as a tractor. The transmission system has been designed so that an independent control of the traction members is obtained. The power of the two-cylinder, four-cycle motor is transmitted through a main friction clutch to the transmission. The belt pulley is on the end of the transmission or first cross shaft and stops and starts with the main engine clutch. This shaft has a gear which meshes with a large gear on a jack shaft immediately below it. Two expanding band friction clutches are mounted on this shaft, each controlling one of the chain sprockets that transmit power to the driven wheels of the traction tread member. It will be evident that this gives independent control of the creepers and by keeping one clutch out and running with the other it is possible to turn a machine in a circle having a diameter but slightly greater than the length of the machine.

The engine is rated at 20 h.p. at 750 r.p.m. and has cylinders of 6-inch bore with a piston movement of 6¼ inches. The engine will develope 12 h.p. at the drawbar or produce a drawbar pull of 2,000 lbs. The length of the tractor is 9 feet over all with a width of 6 feet 9 inches. It is 7 feet 6 inches high with a top and 6 feet 4 inches high without the top. The creeper treads have a total bearing surface on the ground of 2,496 square inches which produces a very moderate ground pressure of about 6 pounds per square inch and enables the machine to work on soft ground. The length of the tread is 7 feet and its width is 12 inches. The effective tread of the machine is 52 inches. The only speed is 2¼ miles per hour, the same speed being obtained on forward and reverse. The steering is by separate control of the traction members. The machine is rated at 20 brake horse-power (which means that that amount is available for belt work) and 12 tractive horse-power.

Tractor and Trailer Train for Ore Transportation

MANY mines which contain high-grade ores are located in relatively inaccessible places so that the problem of transporting the ore economically from such mines to the smelter is an important one and the success of the enterprise depends largely on its solution. It is not always profitable to construct a special railway for ore transportation nor are cableways or aerial tramways always practical. The officials of mines in the Big Cottonwood district of Utah were confronted with the problem of hauling their ore from the mines in the hills to the smelters in the valley and to bring coal and other supplies back. Hundreds of teams were first employed to haul the ore, but the transportation cost proved excessive. Automobile trucks were then given a trial and even this normally economical system of transportation proved impractical because of the large initial investment needed to secure a fleet of trucks sufficiently large to handle the freight. Track laying tractors and trailers were tried for four weeks, but these did not have sufficient speed to handle the large output of the mines. Before deciding definitely on building a railroad for handling ore the officers of the company tried out tractor-trains and after severe tests found that these were the logical equipment for the work.

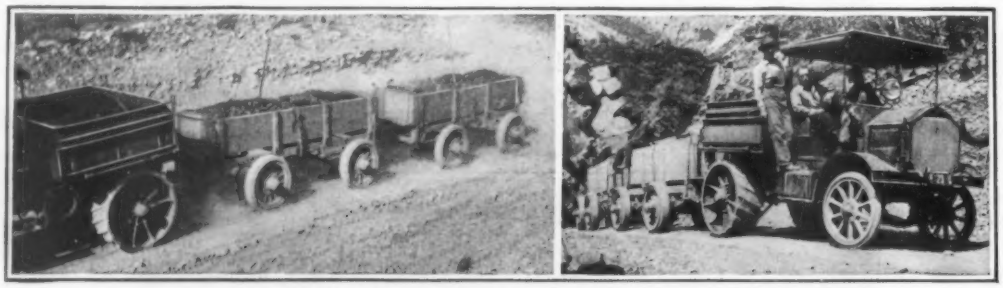
The trial equipment consisted of a military type four-wheel tractor equipped with 5-ton ore body and two 5-ton rubber tired trailers equipped with special steering apparatus so that they would track with the tractor. This made is possible to haul a minimum of 15 tons of ore on one trip, whereas if a regular motor truck of 5-ton capacity had been used this would have required three trips to haul the same amount. On the down trips from the mine it was necessary to hold the trailers back by the brakes on the tractor, as practically the entire distance was down hill and the grades in some places were as steep as 16 per cent. The tractor was fitted with steel wheels, 14 inches wide which were fitted with diagonal cleats to give traction. Eleven demonstrations were made up and down the canyon and some of these took place during heavy rainstorms. The distance covered included nine miles within the



New creeping grip tractor which dispenses with supplementary wheels and has short turning radius

canyon itself and seven miles across the valley. Two trips were made every twenty-four hours. The average time coming down was 3½ hours and returning 4½ hours, which, with an allowance of one hour for loading and unloading gave three hours for oiling, taking on gas and inspecting the machine.

The average gasoline consumption was 21 gallons per round trip and 2 quarts of lubricating oil were used. As the average load of ore handled each trip was nearer 20 tons than the actual capacity of the machines it will be evident that this tractor train is a very economical means of transportation. The contractors now engaged in hauling the ore are using tractor-trailer trains of the type illustrated, exclusively, and report complete satisfaction with the performance of these hauling units. A road tractor of this type is a very practical machine for general contracting work. A winch is provided at the back of the chassis and can be operated by the engine power. Even if traction cannot be secured at the wheels it is always possible to pull the tractor out by anchoring the winch cable to some fixed object, because the great reduction of engine speed and attendant increase in hauling power at the winch will move the machine even if the wheels will not do so. The winch is also useful in hauling loaded trailers out of a gravel pit or cellar excavation as it is not necessary for the tractor to leave the firmer ground at the edge of the pit. Of course it is not difficult to back down with a couple of empties as these may be left for loading and the tractor work out itself. The two trailers that had been previously left have been filled meanwhile and can be taken away to their destination. It will be evident that a winch equipped tractor of this type can be used very nicely in many contracting projects.



Use of military type tractor-trailer train in ore transportation

Usefulness of engine-operated winch at rear of tractor for pulling trailers out of a pit

Utilization of Army Trucks After the War

THE French Minister of Agriculture has appointed a committee for the purpose of studying a practical method of utilizing the trucks discharged from the service by the Minister of War, and a favorable report has been made relative to their possible utilization for agricultural purposes. When the war is over, there will be an extremely large number of trucks released, and while many of these will not be fit for further service without an extensive and expensive overhauling, there will be a large number of others which can be applied to many industrial uses. One of the ideas advanced by the commission was that many of the motors from trucks that were no longer operative, due to chassis defects, could be repaired at relatively small expense and sold to the farmer so that he could use them for power for a variety of agricultural purposes, particularly for driving the stationary machinery of farms, such as mills, feed grinders, ensilage cutters, churns and separators, pumps, dynamos, etc. This transformation of the car motor into an agricultural motor is looked upon to solve an economic problem of the highest importance under present circumstances.

While the Minister of Agriculture has been encouraging the French farmers to use internal combustion engines for some years past many of the agriculturists have hesitated to purchase on account of the high price of new motors. It is expected with the used motors available at a low price that excellent results will be obtained after these have been given a proper overhauling. Then again one may expect the transformation of a certain number of motor trucks into tractors, hauling by direct connection, or into those types operating by means of a winding drum and rope where heavy work, such as plowing, is to be attempted and the drawbar pull of the machine is not sufficient to pull the plow directly yet the motor power is ample to draw the plow by means of a winch arrangement. It has been suggested that the wheels may be altered by removing the rubber tires and replacing them with special wooden felloes shaped to meet the requirements and to which wide steel tires equipped with suitable grouters may be fastened. It is said that the tire width should be computed on a basis of not less than 330 pounds load per inch width. For working on soft ground it would be advisable to increase the width as much as is practical. In order to obtain sufficient traction a certain amount of ballast must be carried so as to give the driving wheels sufficient adhesion. It is claimed that the transformation of any motor truck of sufficient power to a direct hauling tractor can be accomplished at a cost ranging from $250 to $300.

This whole scheme for the utilization of army trucks at the close of the war will save many valuable machines from the scrap heap and give employment to the drivers.

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A Working Model of the "North Dakota"

(*Continued from page 79*)

boat crane, with the proper ropes, working pulleys, electric winch, etc., which is provided to place the launches in the water.

The motive power of the "North Dakota" consists of a 6-volt storage battery, which drives the propelling machinery and the turret turning mechanism. The ship has twin screws and each propeller is driven by three separate electric motors, coupled together on the same shaft. As small motors of the type employed run most efficiently at full load this arrangement fits in very satisfactorily, three permanent speeds being thus available. On the first speed the last motor of each shaft receives power, the other two revolving idly. On the second speed the last two motors of each unit are given current, and on full speed all six motors drive the ship ahead. On reverse, the last two motors revolve the propellers backward, this giving quite sufficient power for the purpose.

The battery has sufficient power to drive the boat for 1½ hours at full speed, 2½ hours at second speed and nearly five hours at first speed. Following out the scale-model idea two ventilators have been employed to operate the controller and reversing mechanism. As a result, no levers, wheels or handles are necessary on deck which would give the "toy-boat" effect so noticeable on most models.

This model, like most of those constructed by Mr. Myers, is arranged to steer by wireless telegraphy, so that when the boat is in the water the pressing of a key on the sending station on shore will cause the rudder to move in any one of three different positions: Straight ahead; to port; to starboard. This scheme for steering by wireless has been employed by the builder of the "North Dakota" on his various models for a great many years and his first experiments, begun as long ago as 1904, antedate any others on the subject so far as he knows. His original idea was to steer torpedoes by this means and a model of the battleship "Connecticut", which he constructed in the winter of 1904-05, was equipped with such a steering device, the idea being that if it worked satisfactorily on the model, a modified form of the same apparatus could be employed for directing torpedoes. It might be said that while he has found the idea perfectly well suited to the steering of his models, his opinion, based upon study and experiment over the past 12 years, is that the wireless-directed torpedo as a serious weapon of warfare is a myth, pure and simple.

We show a photograph of part of the mechanism used in steering the model of the "Connecticut." The two shafts projecting on one side are connected with the two propeller shafts (the model having twin screws) and carry pinions which mesh with the four large gears shown in the center. These gears are shifted by means of a ratchet device actuated by the electromagnets shown at the other end. Each gear has part of its teeth removed, the number remaining determining the position to which the rudder will be moved. This steering mechanism is therefore "selective," that is, if it is not desired to steer to the position that would be determined by the gear next to be brought into mesh, the set of four gears can be quickly shifted into whatever position be desired by a sufficient number of quick impulses on the sending key. The electromagnet which shifts the gears is operated by means of the usual coherer relay arrangement.

In the case of the "North Dakota" the steering mechanism was considerably simplified and the shifting gear arrangement discarded entirely. In its place a worm-gear was provided which turned a large 48-tooth spur-gear. On the spur-gear was an ordinary crank, and from that a connecting rod transmitted the motion to the rudder. The rudder therefore goes through the three different positions in *sequence* and it is a simple matter to secure any position desired, if not the next one to come, by "rushing" through those

(*Concluded on page 88*)

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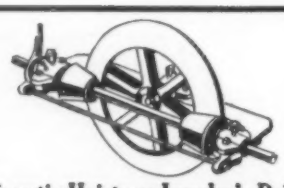

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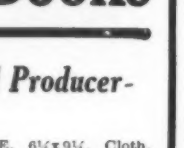

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¶ This is the most complete book on the subject of compressed air and its applications that has ever been published, and covers almost every phase of the subject that one can think of. Taken as a whole it may be called an encyclopedia of compressed air. It is written by an expert, who has dealt with the subject in a comprehensive manner, no phase of it being omitted.

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A Working Model of the "North Dakota"

(*Concluded from page 87*)

not wanted. The worm-gear is operated by an electric clutch. Two electromagnets are revolved by a belt from the port propeller shaft close to, but not touching, a soft iron disk which is coupled to the worm-gear. As soon as current is turned into the electromagnets (through the usual coherer and relay) they "bite" the disk and transmit their rotation to the latter, thus turning the spur-gear and moving the rudder. When the latter has reached the end of its stroke a connection is made with the decoherer which shakes up the coherer and breaks the connection on the relay and subsequently on the magnets. The latter loosen their grip on the disk which then ceases to revolve, and the rudder remains fixed in its new position.

All this is, of course, a simplified description of what occurs. As a matter of fact there are four or five other magnets which have special functions to preform, and a good illustration of the complexity of the whole contrivance may be obtained from the fact that from the time the sending key on shore is pressed to the time the rudder is in its new position, no less than sixteen separate mechanical and electrical operations take place.

More About the Omaha Bridge

(*Concluded from page 79*)

of the old-fashioned solid masonry type into an up-to-date steel-frame skyscraper. Two of the cuts which we present herewith show phases of this work, as is explained by their captions.

In addition we show a magnificent view of the bearings over which the old and the new bridge structures were rolled into placed on the temporary and permanent supports, respectively. The tracks of steel rails above and below the rollers are well shown, together with the rollers themselves and all the supporting blocks, tackle, etc., necessary for the moving.

The development of twentieth century railroading is well illustrated by the state of affairs which has prevailed at the bridgehead for the past few years. Twenty-five years ago, when the bridge was in its prime, locomotives were small—eight-wheelers for the best part—and fifty-ton box cars as well as ponderous Pullmans were undreamed of. Year by year, as trains grew longer and heavier per unit of length, the use of the bridge had to be attended with even greater precautions, until for some years past it has been the rule that only one train might be on the structure at a time. This, of course, reduced it to the level of a single-track bridge. Notwithstanding that, it has been necessary for the larger trains to creep across the river at a snail's pace, so that there has usually been a line-up at either end, and trains have often had to wait an hour or more for their turns. This state of affairs is of course completely done away with by the new bridge.

The Vast Literature of Mathematics

A RECENT address by Prof. T. E. Mason called attention to the immense amount of mathematical research that is going on in the world, as evidenced by the growth of mathematical literature. The mathematical subject index of the "Royal Society Catalogue of Scientific Papers," which covers the literature of the nineteenth century alone, contains 38,748 entries. G. Valentin of Berlin has collected a list of 150,000 titles of books and articles published before the beginning of the twentieth century. The *Jahrbuch über die Fortschritte der Mathematik* constitutes a yearly volume of about 1,000 pages, containing very brief reviews of books and papers published in about 200 serials. A very conservative estimate would place the number of contributions to mathematics published each year at about 2,000, not including works that contain no new matter. It is estimated that during the first fifteen years of the present century the published results of mathematical research amount to about one-fifth as much as during all time before.

American Industries Threatened

American manufacturers have been supreme in turning out high grade machinery and going a long way toward winning the world market, in spite of high labor-cost and of methods in some respects both wasteful and inefficient.

To maintain leadership after the war, our manufacturers *must* correct their methods, eliminate the inefficiencies, adopt standardization.

There is shown below a Thread Limit Gage, one of the many G. T. D. Gages. The two pairs of points are set by standards to maximum and minimum limits respectively and sealed. Any bolt that is too large will fail to pass the upper points, or if too small will fail through the lower ones.

Using Limit Gages, an inexperienced workman can gage thousands of parts in a day, without error in measurement, and the manufacturer *knows* the parts will be interchangeable. Not only is accuracy insured, and material and money saved, but also assembling of parts is much more rapid, and the average quality of the finished product greatly improved.

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

GARMENT HANGER.—E. T. PALMENBERG, 63 W. 36th St., New York, N. Y. The object of this invention is to provide a new and improved garment hanger more especially designed for supporting ladies' waists and similar garments and holding the same against accidental slipping off should the garment be left unbuttoned or open at the time.

LIFE BELT.—J. S. PEROTTI, 228 Peterson Ave., East Rutherford, N. J. Among the principal objects which the present inventor has in view are: to provide an article adapted for rapid and easy installation in service; to store said article in a small compass; and to provide means for holding the article in service position.

Electrical Devices

ALTERNATING CURRENT MOTOR.—H. W. JEANNIN, 300 Porter Ave., Warren, Ohio. The invention relates to motors of the repulsion—induction motor type. The invention improves the construction and operation of the apparatus which is reliable and effective in use, comparatively simple and inexpensive to manufacture and keep in operative condition, and so designed as to be of great efficiency in the conversion of electric into mechanical power.

AUTOMATIC RINGING MECHANISM FOR TELEPHONE SYSTEMS.—C. E. MYERS, Ironton, Mo. The object here is to provide a ringing mechanism for telephone systems. It provides a ringing mechanism for telephone lines, which is automatic to this extent, that when a ringing key is pushed, the device will serve to effect certain current connections, for the sending of an alternating current to the sub-station, to effect the ringing of the signal.

Of Interest to Farmers

ANIMAL SHEARS.—E. T. BARTLETT, SR., care of Sheepshearer's Mdse. & Commission Co., Box 1422, Butte, Mont. The invention has particular reference to clippers for shearing sheep. It overcomes former objections in shears by providing a hood or elongated dome which is adapted to surround the tension device for the dolly pin so that no portion of said device will project beyond the end of said hood, thereby permitting an easier and more rapid manipulation of the shears through the wool.

Of General Interest

FRICTION TOP CAN.—M. SHALITA and P. SHALITA, 264 South St., New York, N. Y. The improvement provides for the rim of a can, a top having a construction of friction flange having several peculiarities, among which is an annular pocket for the reception of a modicum or quantity of the fluid contents of the can, such pocket and any liquid which may be received and held thereby forming an efficient liquid seal for the can.

Hardware and Tools

HOSE COUPLING.—A. ANDREOLLI, Box 195, Meadow Lands, Pa. The invention provides a coupling wherein the coupling members are connected together without the use of screw threads or the like, and wherein the pressure of the water passing through the coupling assists in maintaining the connection water tight, and wherein the members are easily connected and disconnected.

Household Utilities

WINDOW VENTILATOR.—W. H. WEST, Trincheria, Colo. The main object here is to provide a device for use in a window frame of the conventional vertically movable sash type and by means of which device the degree of ventilation may be in complete control while preventing direct air currents upon an occupant of the room so ventilated.

Machines and Mechanical Devices

BOX-SHOOK COUNTING MACHINE.—E. P. DUNBAR, Prescott, Ore. This machine is readily adjustable both to varying sizes of shooks and count bundles of various numbers, is wholly automatic in its operation, will receive the shooks from either a single or twin band resaw machine without the necessity for an intermediary, and by these means the disadvantage resulting from errors in the count will be wholly eliminated.

Prime Movers and Their Accessories

VALVE.—W. J. LILLY, 810 W. Galena St., Butte, Mont. This invention relates to valves suitable for use as throttle valves or cut-off valves, such, for instance, as are used in connection with hoisting engines and the like. More particularly stated the aim is to produce a valve which is completely balanced and which is guided with great accuracy.

Designs

DESIGN FOR A DISH OR SIMILAR ARTICLE.—T. B. ANDERSON, Box 630, East Liverpool, Ohio. In this ornamental design the article is circular in form and has a handle on each side, and one in the center of the cover of the raised portion of the dish.

DESIGN FOR A BAKING PAN.—P. RIESS, 820 4th St., New Orleans, La. The pan consists of two similar members hinged together and presenting each, a plurality of convex oyster shaped projections arranged radially of a common center, and two similar handle members joined to the respective mold members.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

German Substitutes for Rubber Bicycle Tires

THE scarcity of rubber and the partial commandeering of rubber bicycle tires have caused a number of substitutes to appear on the German market. The substances used are steel wire, leather, wood, prepared canvas, and combinations of these substances.

The first substitute to appear was a tire made of steel wire, about $\frac{3}{16}$ inch thick, which was made up into a very close coil, the two ends being welded together so as to give it the proper shape. The wholesale price of this product is now 12 marks ($2.86), and it is retailed for 18 marks ($4.28). Besides the fact that the price is high, the steel-coil wire has the additional objection that it cuts into the pavements and rattles considerably when in use. The latter objection might be overcome, it is said, by placing a layer of felt between the rim and the tire, but this would increase the price.

Wooden tires have been used with some success. At least three different types of which wood is the main part are sold in Germany. In a few cases the tires are made of a single piece of wood, and retail at 4 to 6 marks ($0.95 to $1.43). Sectional wooden tires also have appeared on the market. One of these is composed of 47 parts. These are 12 wooden tire-sections of three different kinds, 12 tin plates, 12 screws, 10 connecting pins, and a thumbscrew. The tin plates are used to secure the sections to the rim, which must be of metal; the screws to attach the tin plates to the ends of the sections; the connecting pins to hold the sections together, and the thumbscrews to put through the valve hole in the rim and thus tends to attach the tire more firmly to the rim. The manufacturer is selling this wooden tire for 6 marks ($1.43); but in reality the expense is a little more, for in order to give satisfaction shock absorbers in the form of steel springs must be attached to the fork of the front wheel. These springs retail at 7.50 marks ($1.78) and are also to be had through the manufacturer of the tires.

A third wooden tire which is extensively advertised is said not to be meeting with great success on account of the price. This is made of one piece of wood, the outer surface of which is covered with a small strip of leather. Between the under surface of the tire and the rim several steel springs are placed with a view to securing elasticity. In addition to this, large steel springs are attached to the front and back forks. The cost of this outfit, including the two tires and the large springs, is 36 marks ($8.57).

Several leather-covered and canvas-covered tires also are on the market. These are solid, the outer casings being of leather or prepared canvas, and the inner part consisting of wood and other substances. To make the tire more durable small pieces of steel are often affixed to the outer or wearing surface. The prices for products of this class vary. One fairly good leather-covered tire retails at 48 marks a set ($11.42); another at 70 marks ($16.66).

The tire that is said to have the strongest claim to being a real substitute for the rubber article is composed of two parts, corresponding to the former inner and outer tires. The inner part, which is most important, is solid and is covered with cloth made into the shape of a tire. The tube is filled with a preparation resembling rubber. The outer tube is composed of prepared canvas and is said to have very good elasticity, so that it can be used without springs at either of the forks. The price for a set of these tires is 52 marks ($12.38). This will doubtless tend to restrict their use.

The most practical tire, from the point of view of both price and service, seems to be the sectional wooden tire.

Two New Wireless Stations for Colombia

IT is reported that the two Marconi outfits purchased by the Colombian government some time ago will soon be delivered. It is intended to establish these two stations at Arauca and Orocue.

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Your Mitchell dealer now can show you the Mitchell in two sizes. One is called Mitchell Junior. It is simply a reduction of the larger Mitchell.

It is for men who want a 5-passenger car, and who don't want to pay for size and power not needed. It has 40 horse-power—enough for five passengers. It has a 120-inch wheel-base—more than ample room.

It brings all the Mitchell attractions—nearly all the Mitchell extras—in a car at a lower price. We have doubled our capacity to build as many as we build of larger Mitchells.

Hundreds of Extras

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There are 31 features—like a power tire pump—which nearly all cars omit. To include them this year on the Mitchell output costs us $4,000,000.

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And the Mitchell now has 100 per cent over-strength in every vital part. That is, each part is twice as strong as need be.

Our former standard was 50 per cent over-strength. That gave us marvelous endurance. But this new standard means a lifetime car.

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All these extras are paid for by factory savings. They are due to John W. Bate, the great efficiency expert, who built and equipped this plant.

Under his methods our factory costs have been cut in two. Nowhere else could a car like the Mitchell be built at anywhere near our cost.

The result shows in these extras. Over 440 parts in the Mitchell are built of toughened steel. The most important parts are built of Chrome-Vanadium steel. Steering parts and axles are all oversize. Then the extra features and extra luxury are found in no other car at this price.

Go and see these extras. See what they mean to you. It will certainly mean, if you buy a fine car, that you want a Bate-built Mitchell.

TWO SIZES
$1460 For 7 Passenger Six—48 h. p. 127-inch Wheelbase.
$1150 For Mitchell Junior—40 h. p. 120-inch Wheelbase Six.
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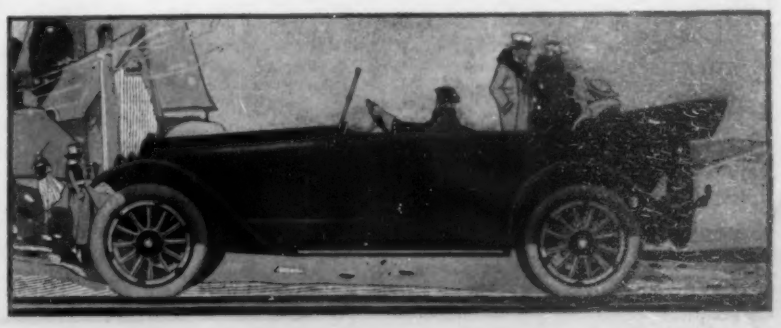

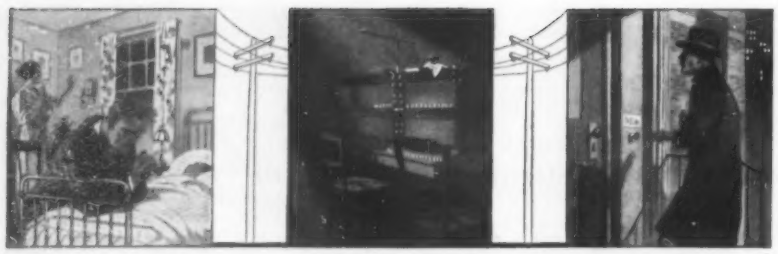

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Prompt connections, the speed of answer in principal cities averaging about 3½ seconds.

Lines provided to give immediate toll and long-distance service.

In Europe:

Nine-tenths of the exchanges are closed at night, and in many cases, at mealtime.

Not one person in a hundred has a telephone.

Not one-eighth as many miles in proportion to population and territory.

In the principal cities, it takes more than twice as long for the operator to answer.

No such provision made. Telephone users are expected to await their turn.

As to cost, long-distance service such as we have here was not to be had in Europe, even before the war, at any price. And exchange service in Europe, despite its inferior quality, cost more in actual money than here.

Bell Service is the criterion for all the world, and the Bell organization is the most economical as well as the most efficient servant of the people.

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NEW BOOKS, ETC.

THE ELEMENTS OF THE GREAT WAR. Two Volumes. By Hilaire Belloc. New York: Hearst's International Library Company, 1915. 8vo.; 379 pp.; illustrated. Price, $1.50 each volume, net.

Ask the average man what is the cause of this world calamity, and he will probably answer, "Nobody knows!" But since every effect has its cause, or more frequently its causes, it is to our national advantage that we should in this case search for an adequate explanation. No better man could be found to present to the general reader the Allies' views of this question; the author finds the answer in a clash of attitudes and wills, plus particular causes, plus an immediate occasion, and it will be hard to controvert his conclusions. As a military history, his first volume deals with the first phase of the war, contrasting the forces opposed and describing the first shock which resulted in entrenchment and deadlock. His second volume covers what he has termed the second phase of the conflict, and is mainly descriptive of the battle of the Marne. The French strategy of the "open strategic square" is exhaustively treated; indeed, the constant repetition might constitute a fault were it not that each repetition has elements of novelty, and is admirably designed not only to fortify the memory but to further enlighten the mind. The work is a most noteworthy contribution, making up in vitality what it must necessarily lack in perspective, and the four volumes projected to complete the history will be eagerly awaited by those who have followed the historian through the first and second phases.

AERIAL RUSSIA. The Romance of the Giant Aeroplane. By Lieut.-Col. B. Roustam-Bek. New York: John Lane Company, 1916. 8vo.; 154 pp.; 20 illustrations. Price, $1 net.

The subject of Lieut.-Col. Roustam-Bek's work has been exploited in a somewhat superficial manner by the American press, but it is safe to say that the general reader will find in it, as the author ventures to hope, a quite absorbing revelation. There is the story of the young Scotsman, Kennedy, who received his technical education in the United States, and who has been an influential factor in Russia's aeronautical development. Sikorsky of course looms large across the pages; but neither of these talented youngsters could have achieved their present positions had not official Russia been progressive enough to place money and facilities at their disposal. A most illuminating glimpse is given us of the enthusiastic constructors, aviators and workmen; the famous flying men are given a chapter to themselves, and an attempt to bring England and Russia into a better understanding and a closer intimacy. One of the illustrations shows the world's largest aeroplane, the Kennedy No. 3, and all the illustrations are well chosen and highly interesting. It is the author's opinion that the giant aeroplane alone can adequately cope with the Zeppelin, and that Russia's development of this type has saved her from numerous disasters.

MECHANISMS OF CHARACTER FORMATION. An Introduction to Psychoanalysis. By William A. White, M.D. New York: The Macmillan Company, 1916. 8vo.; 335 pp. Price, $1.75.

It is the writer's contention that the pendulum of psychology has swung too far for practical results, lingering too long in the region of metaphysical abstractions on the one hand, and in the field of refined physiology on the other, and that man has been regarded rather as an object of experiment than as a human being in a social environment. Psychoanalysis had its origin in an effort to help the ailing, and offers, so the author believes, the greatest pragmatic advantage. His work is issued primarily as a guide for the physician, but with the hope that this sphere of usefulness may be speedily extended, and it lays down the broad principles underlying human behavior in order to pave the way for a true appreciation and understanding of mental facts.

PLAIN AND ORNAMENTAL FORGING. By Ernst Schwarzkopf. New York: John Wiley & Sons, Inc., 1916. 8vo.; 277 pp.; illustrated. Price, $1.50.

Designed for the self-instruction of the beginner in plain and art forging, this text embodies thorough experience and competent instruction. Absolute control of the hand is aimed at by practice exercises that call for blows that are carefully calculated and take into account the strength of the metal, the weight of the hammer, and the required result. Methods of upsetting, offsetting and shouldering are clearly explained, as are welding, forging and tool making. The interest of the student is kept at a high point by combining the practical and ornamental elements, and an appendix sets forth many common processes and offers some useful tables.

FLOW OF WATER IN PIPES. By George T. Prince, C.E. New York: D. Van Nostrand Company, 1916. 12mo.; 149 pp. Price, $2 net.

In a little book convenient for the pocket, the author presents some explanatory notes relating to the flow of water under pressure through clean closed pipes. His tables, covering various sizes of pipe, from 4-inch up to 120-inch, indicate the formula, give the fall per thousand feet and the mean velocity in feet per second, and show the corresponding discharge in cubic feet per second, in the United States gallons per minute, an in million gallons per twenty-four hours. His experience with continuous wood-stave pipe is also embodied in the discussion and tables.

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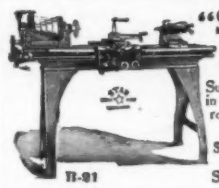

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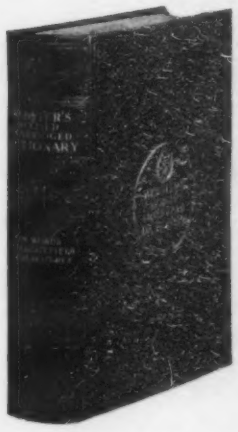

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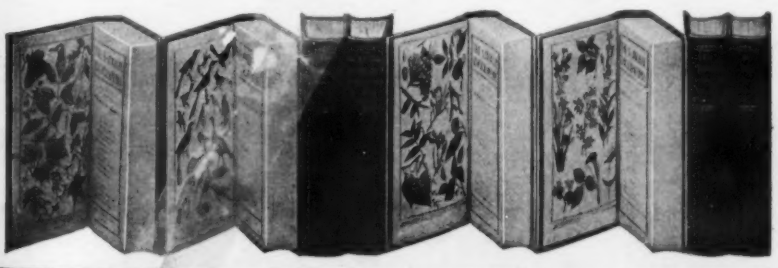

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— secret of earth's dawn
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—even today, still nature's paradox, riddle of science—yet one of man's most useful servants.

* * *

MILLIONS of years ago, Mother Earth drew closer her mantle—and in countless fissures of the folded rock, through untold ages of flame, a marvelous mineral slowly formed. Nature's gift —Man's armor against fire—Asbestos.

Millions of years later an audience faces a theatre curtain—on it this word Asbestos, spelling safety. Around are brilliant lights, energized from distant generators through a system safeguarded by this same Asbestos. Many here live or work in buildings roofed with Asbestos; here, too, are many housewives whose dining tables it protects. Even the motor cars, waiting without, have brakes lined with this same Asbestos —mineral of many marvels, fashioned to meet man's needs.

Think of a rock, heavy and dense as marble, yet a nugget of silky fibres, a floss like thistle-down. Each fibre so light it floats on water—yet so rugged that these million years mid the chaos of earth's change have neither broken its slender thread nor marred its silken sheen. Like wool or flax, yet a mineral, both crystalline and fibrous, brittle and pliable—this is Asbestos—Nature's paradox.

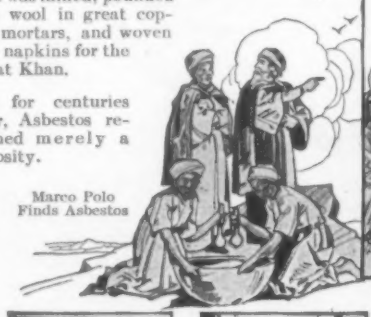
The Ancients Held it in Awe

and wonderful tales grew with each telling. Legend made it the hair of the Great Salamander, the lizard that lived in fire; or again a wonderful plant immune to flame. Small wonder that Asbestos became the stage property of Magi, the costly curio of kings and their shroud on the funeral pyre.

Charlemagne astounded his warrior guests by flinging the cloth of Asbestos from the table into the fire, only to withdraw it unburned—even bleached and cleansed by the flame.

Marco Polo was the first to set his little world to rights. Returning from Tartary, he wrote, "In this same mountain there is a vein of the material from which Salamander is made. For the real truth is that the Salamander is no beast, as they allege in our part of the world, but is a substance found in the earth." And he tells how the rock was mined, pounded into wool in great copper mortars, and woven into napkins for the Great Khan.

But for centuries after, Asbestos remained merely a curiosity.



Marco Polo Finds Asbestos

The Shroud of Kings

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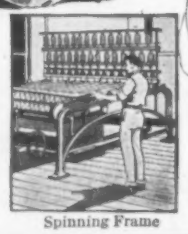

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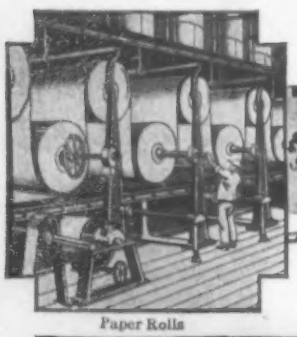

Paper Rolls

Works at Manville, N.J.—one of the many Johns-Manville factories

Unique Combination of Properties

Compared with other materials, its aggregation of properties is unparalleled. Wood burns—Asbestos is unchanged by flame or by temperatures of 1500° F. Stone disintegrates—Asbestos defies erosion. Steel rusts —Asbestos is immune. Asbestos resists wear and the action of oxygen and acids, is a non-conductor of electricity, and insulates against heat or cold. The old Greeks named it ἄσβεστος—"inconsumable." And nothing was ever better named.

Its Service to Man But Begun

Had someone championed Asbestos earlier, the world today would be further along. The Chicago fire might never have happened—indeed, it is probable that 50 years hence the community fire will be a finished page as the Asbestos roof gains ever wider acceptance.

Steam pipes, once plastered with mud, are now being insulated by Asbestos to prevent waste of heat; engines improve their economy by Asbestos packings. Modern chemistry, too, requires this marvelous mineral for its filters. At every turn, in the homes or workshops of the nation, we find Asbestos, converted into useful form.

How It Was Made Useful

Natural products are usually developed by necessity. But it was left to the vision and foresight of a business institution to realize the possibilities of Asbestos—and to supply the effort, the courage and resources to make Asbestos what it is today.

To really appreciate the task so successfully mastered by Johns-Manville requires a trip through one of their ten great factories. One must see giant machinery transform rock into felts — see paper pressed from pulp—see fibre and wire pressed back into rock-hardness for the brake blocks of some great lift or dredge.

Charlemagne's Table-Cloth of Asbestos

In another section a complete textile mill, where this same rock of Asbestos is spun or woven—spun into thread so fine that a hundred yards weigh but an ounce—woven into cloth like linen or into heavier fabrics as thick as your finger.

On one side a tailor making clothes of flame-proof cloth; on another this same Asbestos combined with rubber for engine, pump, or compressor packings,—again into cements to withstand fierce furnace heats.

So it is made into Shingles, Roofings, Brake Linings, Insulations, Cements, Electrical Devices, Tapes, Clothes, Yarns—hundreds of products that enter every avenue of science and the useful arts.

Through Asbestos Johns-Manville has made industrial history—has contributed to progress—has made life safer and more complete. It has taken the mystic mineral, the curio, the paradox of the ages, and made it serve Man. A task for any 50 years, and surely an achievement which justifies the linking of Asbestos with Johns-Manville.

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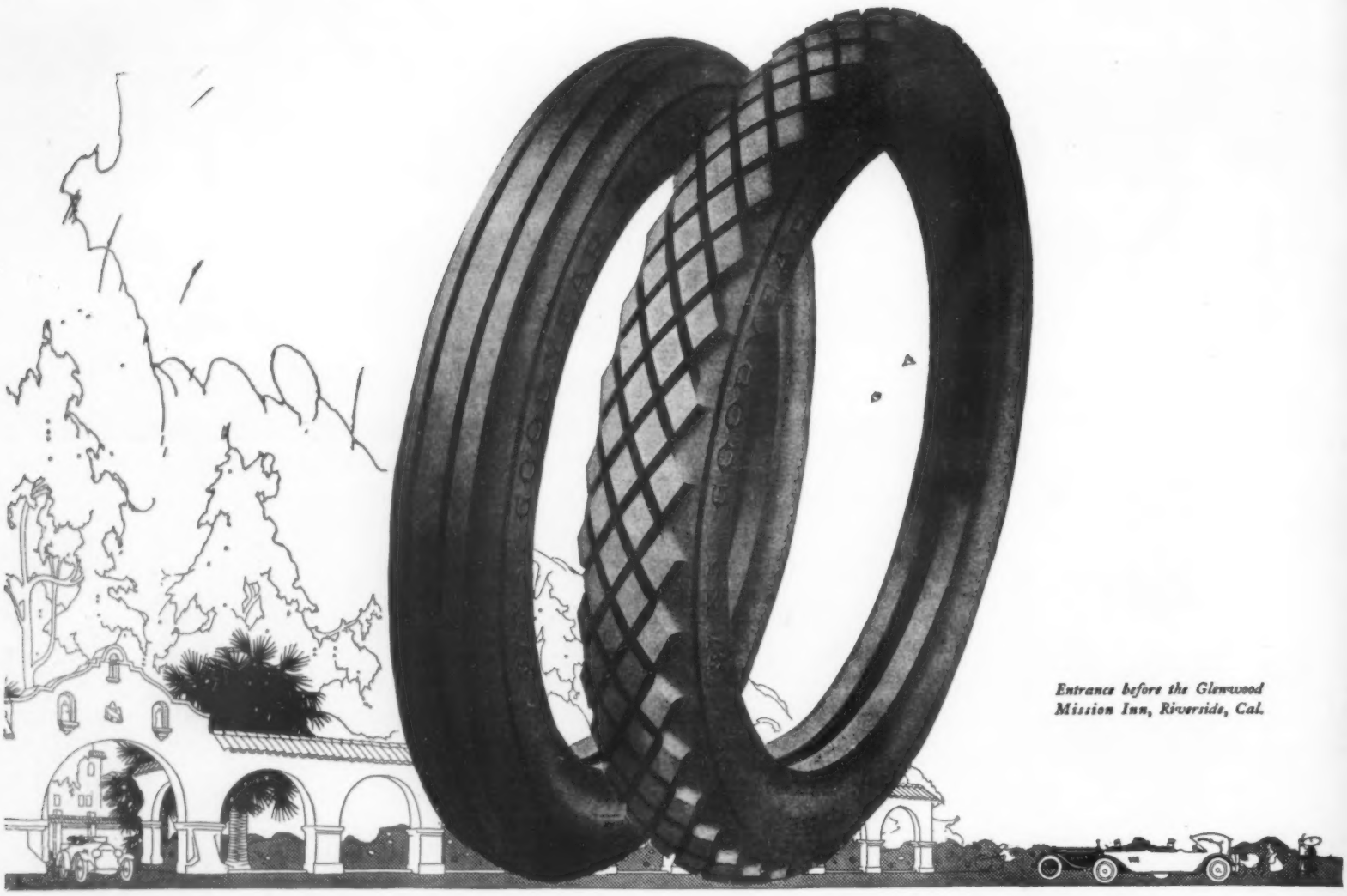

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The Ribbed tread we use, of European design, has no pronounced non-skid virtue, and we recommend it rather for use on front wheels.

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